APR 1 21928

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLV.—No. 3768] LONDON: FRIDAY EVENING, MARCH 30, 1928 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 17th April, 1928, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at Bridlington P.O., &c

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8108

The Director-General, India Store Department, Belvedere road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—TWO DIESEL LOCOMOTIVES for 5ft. 6in. gauge.

SCHEDULE 2.—48 LOCOMOTIVES for 5ft. 6in. and metre gauges.

Tenders due on the 1st May, 1928, for No. 1, and on the 4th May, 1928, for No. 2.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 8130

Royal Ordnance Factories.

An ENTRANCE EXAMINATION for ENGINEERING APPRENTICES will be held at Woolwich and at Ponders End, Middlesex, on JUNE 14th and 15th. Youths between the ages of 15 and 17 on the 1st September next are, subject to certain conditions, eligible for candidature.

Applications to enter for the Examination must be made by 1st May, 1928.

Application forms and full particulars may be obtained from the CHIEF SUPERINTENDENT OF ORDNANCE FACTORIES, Woolwich Arsenal, S.E.18. 8090

Borough Polytechnic Institute.

LONDON, S.E. 1.

HEAD OF DEPARTMENT OF MECHANICAL AND STRUCTURAL ENGINEERING.

The Governors invite APPLICATIONS for the POST of HEAD of the MECHANICAL and STRUCTURAL ENGINEERING DEPARTMENT, rendered vacant by the retirement of Mr. G. E. Draycott. The remuneration will be in accordance with the approved London salary scales (£675-£25-£830 at present). Full-time service is required. Particulars of the appointment and forms of application may be obtained by sending stamped addressed foolscap envelope to the undersigned.

J. W. BISPHAM,
Principal.
8127

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

224 PAIRS WHEELS WITH STEEL AXLES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 26th March, 1928.

A fee of 20s. will be charged for each specification, which is nor returnable.

Tenders must be submitted not later than Noon on Wednesday, 4th April, 1928.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board.
R. C. VOLKERS,
Secretary.
26th March, 1928. 8096

Chorleywood Urban District Council.

SEWERAGE.

TENDERS are INVITED for LAYING SEWERS, including the CONSTRUCTION of MANHOLES, FLUSHING TANKS and SEWAGE DISPOSAL WORKS.

Plans, specification and general conditions may be seen at the office of the Surveyor to the Chorleywood Urban District Council at Chorleywood or at the office of the Engineer, Mr. A. P. I. Cotterell, of 54, Victoria-street, Westminster, during the hours of 9.30 a.m. to 11.30 a.m. and 3 p.m. to 5 p.m.

Copies of the bills of quantities and form of Tender, &c., may be obtained from the Quantity Surveyor, Mr. C. W. Latter, of 44, Bedford-row, W.C., by intending contractors on the payment to him of the sum of £5 5s., which will be returned on receipt of a bona fide Tender and all other documents supplied. All applications for the bills of quantities are to be made to the Quantity Surveyor on or before the 10th April, 1928, after which no further applications will be received.

Tenders, on the form provided, enclosed in sealed envelopes, must be delivered, accompanied by the priced bills of quantities, to the undersigned at Bank Chambers, Chesham, Bucks, and endorsed "Sewerage," not later than Twelve Noon on 30th April, 1928.

Contractors will be required to provide securities for performance of the contract under Section 174 (6) of the Public Health Acts, 1875.

The Council do not undertake to accept the lowest or any Tender.

By Order,
GEORGE S. SCOTT,
Clerk to the Chorleywood Urban District Council.
24th March, 1928. 8097

Clyde Navigation Trust.

TO CRANE MAKERS.

ELECTRIC CANTILEVER CRANE.

The Trustees of the Clyde Navigation invite alternative TENDERS for the CONSTRUCTION and ERECTION of an ELECTRIC CANTILEVER CRANE of 175 tons, 150 tons, and 130 tons lifting capacity, for Stobcross Quay, Glasgow Harbour.

The specification and forms of Tender, along with drawing, may be obtained on application at this office to Mr. Daniel Fife, Mechanical Engineer, on payment of a fee of Three Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, marked "Tender for Cantilever Crane," require to be lodged with the undersigned not later than Noon on Monday, 4th June, 1928.

The Trustees may not accept the lowest or any Tender.

JAS. MACFARLANE,
General Manager.
16, Robertson-street, Glasgow,
26th March, 1928. 8102

The Engineer

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PUBLIC NOTICES

County Borough of Southend-on-Sea.

EASTERN VALLEY PUMPING STATION.
TO MAKERS OF PUMPS.

The Corporation are prepared to receive TENDERS for the SUPPLY of ONE ELECTRICALLY DRIVEN DIRECT-COUPLED CENTRIFUGAL PUMPING SET capable of pumping 270 cubic feet of unscreened sewage per minute through an existing 15in. diameter cast iron rising main, 1555ft. in length, against a static head of 15ft.

The motors should be wound to give normal output at 430 volts direct current.

Tenderers will be required to submit prices for manufacture, delivery and installation of the pumping set on foundations prepared by the Corporation, and the price is to include all necessary cast iron valves and pipes.

A plan of existing pumping station and general conditions may be inspected and copies of form of Tender and specification obtained on and after April 2nd, 1928, on application to Mr. Robt. H. Dyer, Borough Engineer and Surveyor, on payment of a deposit of £2, which will be refunded on receipt of a bona fide Tender and the return of all loaned documents.

Sealed Tenders, addressed to the undersigned and endorsed "Pumping Set, Eastern Valley Station," are to be delivered to this office on or before Twelve Noon, April 30th, 1928.

The Corporation do not bind themselves to accept the lowest or any Tender.

H. J. WORWOOD,
Town Clerk.
Municipal Buildings,
Clarence-road, Southend-on-Sea,
22nd March, 1928. 8089

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

175 TONS STRUCTURAL STEEL WORK for PATTERN SHOP (together with Corrugated Asbestos Sheeting, Patent Glazing with Wired Glass, C.I. Piping, Gutters, &c. &c.).

Tenders are due in by 10.30 a.m. on Tuesday, 1st May, 1928. Tender form obtainable at above address; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 8123

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF A LOCO. STEAM CRANE.

The Metropolitan Water Board invite TENDERS for the SUPPLY of ONE STANDARD LOCO. STEAM CRANE with 24ft. jib (to lift 2 tons at 18ft. radius and 3 tons with snatch block at 12ft. radius), for well sinking at their Deptford Works, Brookmill-road, Deptford, London, S.E. 8.

Tenders must be submitted on the official form, which may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Crane," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 11th April, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
24th March, 1928. 8092

28.3.28.

The North British Aluminium COMPANY, LTD.

LOCHABER WATER POWER.
SPECIFICATION NO. 104.

The North British Aluminium Co., Ltd., is prepared to receive TENDERS for the CONSTRUCTION, DELIVERY and ERECTION near Fort William, Inverness-shire, of :—

STRUCTURAL STEEL WORK for POWER-HOUSE and FACTORY BUILDINGS.

Copies of the specification, conditions of contract and forms of Tender may be obtained on and after 5th April, 1928, at the Company's offices, Adelaide House, King William-street, London, E.C. 4.

Sealed Tenders, endorsed :—
Lochaber Water Power,
Specification No. 104,
Tender for Structural Steel Work,
must be addressed to the SECRETARY and delivered at the Company's offices not later than 10 a.m. on Tuesday, 24th April, 1928.

The Company does not bind itself to accept the lowest or any Tender.

Preference will be given to contractors on the King's Roll. 8122

PUBLIC NOTICES

Epsom Urban District Council.

ELECTRICITY DEPARTMENT.

The Council are prepared to receive TENDERS for the following WORKS and PLANT :—

SECTION 1.—Two 500/600 kW Diesel Engine Driven Alternators and Accessories.
SECTION 2.—E.H.T. and L.T. Switchgear
SECTION 3.—One 500-kW Rotary Converter.
SECTION 4.—Two Sub-stations with Transformers and Switchgear.
SECTION 5.—E.H.T. Cable and Laying.
SECTION 6.—Cooling Tower.
SECTION 7.—Fuel Oil Storage Tank.

Copies of the specification with forms of Tender can be inspected at the office of the undersigned and then obtained on payment of a fee of One Guinea for each copy, which amount will be refunded on receipt of a bona fide Tender.

Tenders, duly endorsed and addressed to the Clerk of the Council, 37, Church-street, Epsom, must be delivered to him not later than 7.30 p.m. on Tuesday, April 17th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

H. W. WATTS, M.I.E.E., M.I. Mech. E.,
Resident Electrical Engineer.
Electricity Works, Epsom,
March, 1928. 8095

Rochford Union.

LANCASHIRE BOILER, STEEL CHIMNEY, &c. &c.

The Guardians of the Rochford Union invite TENDERS for the SUPPLY, DELIVERY, and ERECTION of ONE LANCASHIRE TYPE BOILER, STEEL CHIMNEY, PIPE WORK, &c. &c.

Specification and form of Tender may be had on application to the Guardians' Consulting Engineer, Mr. H. Tomlinson-Lee, M.I.E.E., 28, Victoria-street, Westminster, S.W. 1, on payment of a fee of Two Guineas.

Tenders, endorsed "Rochford Union, Tender for Boiler, Chimney, &c. &c." and addressed to the undersigned, must be delivered not later than 10 a.m. on Monday, April 16th, 1928.

The person or firm whose Tender is accepted will be required to enter into a contract and to obtain a policy of guarantee (to be issued by a society approved by the Guardians) for the due performance of the work. In sending their names to the Engineer two references as to recent work carried out must be given.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
W. HARDING ROBERTS,
Clerk.
27, Victoria-avenue, Southend-on-Sea. 8063

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF STORES, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES and SERVICES, &c., for the periods of 6 and 12 months, commencing 1st June, 1928 :—

Tender No.
1. Bricks, Fire-bricks, Cement, &c.
8. Iron and Steel.
9. Bolts and Nuts, Screws, Files, Shovels, Steam Tubes, &c.
12. Fuel Oil, Oils (Lubricating), Kerosene, Motor Spirit, Greases, Tallow, &c.
19. Iron, Brass, Gun-metal, and other Castings.
20. G.M. Stop Cocks and Ferrules, Outlets and Caps for Fire Hydrants.
22. Timber.
23. Maintenance of Weighing Machines.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed brief envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board" and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Friday, 20th April, 1928.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
21st March, 1928. 8066

Saxmundham Urban District Council.

The Council REQUIRE thoroughly competent ENGINE DRIVER for Waterworks, Maintenance and Working of Suction Gas Plant, and Engines, and Ashley Deep Bore-hole Pumps.

Applications, stating age, qualifications and salary (house provided, rent and rates free), with three testimonials, to reach me by 7th April, 1928.

(Signed) GEO. J. COOK,
Clerk to the Council.
Saxmundham. 8098

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SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for England, WORKS ENGINEER, with good experience in the erection of wet process Cement Works Machinery and its maintenance. Previous experience in this class of work essential. Applications, giving full particulars of age, qualifications and particulars, with dates of appointments previously held, should be received by the 11th April.—Address, P4337, The Engineer Office. P4337 A

A WORKS MANAGER REQUIRED for Small Factory in Midlands, preferably with experience in Spinning of Metals and kindred trades. Must be good organiser with initiative and capable of handling labour.—Address full particulars, age, experience, and salary expected, which will be treated in confidence, P4303, The Engineer Office. P4303 A

ASSISTANT FACTORY ENGINEER REQUIRED, with first-class education and some experience of Industrial Engineering, age about 25.—Apply, stating full details of training, experience, and salary required, by letter only, to the CHIEF ENGINEER, Avon India Rubber Co., Ltd., Melksham. 8103 A

FIRST-CLASS SALESMAN, with General Engineering knowledge, REQUIRED to Take Charge of Midland Area for well-known London Manufacturing Engineers. Only men of proved ability, with successful selling record, will be considered. Salary, expenses and commission. Own car an advantage.—State details of training, experience, age, and salary required, with details of last three posts, to Box 128, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, E.C. 4. 8132 A

FULLY Trained WORKS ENGINEER REQUIRED in North Midlands, to Take Charge of Maintenance, Repair and Construction Work in a Large General Steel Works, comprising Acid and Electric Melting Furnaces, Foundry, Forge, Machine Shops, Electric Sub-stations, &c.

Applicants must be not less than 35 years of age. Several years' previous experience as a plant and maintenance engineer is essential.

State fully, in confidence, particulars of training, previous experience, age, and salary required.

Address, 8024, The Engineer Office. 8024 A

REPRESENTATIVES Calling on Large Engineering Works WANTED for Midlands, also South Wales and West of England. High-class line Pneumatic Tools. Commission only.—Address, giving age, experience, connection, &c., 8104, The Engineer Office. 8104 A

RESIDENT ENGINEER REQUIRED to Supervise large Ferro-concrete Contract in South America. Thorough practical knowledge and organising ability essential.—Address, stating age, salary, and experience, P4356, The Engineer Office. P4356 A

TECHNICAL CORRESPONDENT.—JUNIOR ASSISTANT REQUIRED, with general engineering knowledge. Must be well trained, write good letter, and have had experience.—Address full details, age, commencing salary expected, &c., 8112, The Engineer Office. 8112 A

WORKS MANAGER WANTED for Small Engineering Works in South of England employing about 70 hands; fitting shop, iron and brass-foundry, forge, sheet metal shop, &c., general engineering repairs. Must be good mechanical engineer (with experience Heating and Lighting Plants preferred), accustomed to estimating and good organiser.—Address, giving full particulars experience, age, salary, and testimonials, P4343, The Engineer Office. P4343 A

WANTED, APPRENTICE DRAUGHTSMAN as Improver, to carry out neat sketches of pipe line arrangements in furnace and boiler design.

FILMA OIL BURNERS, Limited, 68, Victoria-street, London, S.W. 1. 8109 A

CRANE DRAUGHTSMAN REQUIRED; Must Have a thorough knowledge of Steam and Electric Crane Details and be capable of producing shop plans quickly and accurately on own responsibility.—Address, stating age, training, experience, references and salary required, 8094, The Engineer Office. 8094 A

DETAILING DRAUGHTSMAN REQUIRED for Constructional Steel Works in North London. Must be able to prepare shop drawings with minimum supervision and be familiar with Steel Frame (1909 Act) Buildings.—Address, stating age, experience, and salary required, P4333, The Engineer Office. P4333 A

DRAUGHTSMEN, Experienced in Bridge and Constructional Steel Work, WANTED by large Midland Firm. Send full details, qualifications, experience, age, salary, and state when at liberty.—Address, 8114, The Engineer Office. 8114 A

DRAUGHTSMAN REQUIRED by Textile Machinery Makers. Must have initiative and knowledge of Spinning and Preparing Machinery.

Opening also available for DRAUGHTSMAN with specialised knowledge of Winding or Weaving Artificial Silk.

State age, remuneration required and full particulars of previous situations.

Address, P4341, The Engineer Office. P4341 A

DRAUGHTSMAN REQUIRED, Used to General Engineering and Colliery Haulage Gears. State age, experience, and salary required.—Address, 8088, The Engineer Office. 8088 A

DRAUGHTSMAN REQUIRED, with Experience of Compressor Design and Detail Work, for works in South-East England. One used to high-pressure work preferred.—Address, stating age, experience, and salary required, 8124, The Engineer Office. 8124 A

DRAUGHTSMAN, SENIOR, REQUIRED, London, Commercial Chassis Design.—Address, stating age, experience, salary required, and when disengaged, P4354, The Engineer Office. P4354 A

DRAUGHTSMEN WANTED, Accustomed to Cranes and Excavators. Good salary will be paid to efficient men.—Write, with full particulars as to expenses, &c., to Box V263, Lee and Nightingale, Liverpool. P4334 A

DRAUGHTSMAN WANTED by Large Engineering Firm in the City, with experience of Pipe Work Lay-out. Good technical qualifications essential.—Address, stating age, experience, and salary required, 8118, The Engineer Office. 8118 A

DRAUGHTSMAN WANTED, Experienced in Structural and Mechanical Work, in connection with Coal-handling Plants. Experienced men only need apply. State age, experience, and salary required.—Address, 8119, The Engineer Office. 8119 A

DRAUGHTSMAN WANTED for London Office, with extensive experience in project work for Mechanical Handling Plants. Only first-class men need apply, stating age, experience, and salary expected.—Address, P4345, The Engineer Office. P4345 A

DRAUGHTSMAN WANTED, London District. Preferably experienced in Condensers, Evaporators and Marine and Power Station Auxiliary Plant.—Address, stating age, experience, and salary required, P4350, The Engineer Office. P4350 A

DRAUGHTSMAN WANTED on North-East Coast having experience of Water-tube Boilers.—Address, stating age, experience, and salary required, 8107, The Engineer Office. 8107 A

DRAUGHTSMAN WANTED, with First-class Experience in Lift Lay-out Work.—Reply, stating age, experience, and salary required, to Box D. 7240, c/o Dawson's, 118, Cannon-street, E.C. 4. 8113 A

DRAUGHTSMAN, with Experience in Steel-frame Buildings.—State fully experience and salary expected to "DRAUGHTSMAN," Artex Ltd., Slough. 8123 A

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SEVERAL Competent DRAUGHTSMEN REQUIRED IMMEDIATELY, with Boiler-house experience, preferably furnace work.—Apply by letter, stating age and salary required, to COMBUSTION ENGINEERING, Ltd., Derby. 7943 A

TEMPORARY DRAUGHTSMAN REQUIRED, with knowledge of Building Construction. Neat and accurate work essential. Age 22-28. Salary £4 per week.—Address, stating age, qualification, experience and with copies of two testimonials, 8126, The Engineer Office. 8126 A

WANTED, TOOL-ROOM FOREMAN in London district, capable of taking charge of small tool-room attached to works. Must have good knowledge of Press Tools and be capable of getting production.—Address, giving age, experience, and salary required, 8120, The Engineer Office. 8120 A

ENGINEER WORKING FOREMAN WANTED for General Works, provincial district, about 20 hands. One used to Traction and Portable Engines, Repairs, Pumps and Agricultural Work; knowledge of drawing essential. Age 30 to 35. Two copies recent references. State salary if good house free.—Address, 8050, The Engineer Office. 8050 A

FOREMAN REQUIRED for Machine Shop Producing Internal Combustion Engines. Must be first-class production man with initiative. Knowledge of Toolmaking an advantage. State full experience and salary required.—Address, 8099, The Engineer Office. 8099 A

LARGE and Old-established FIRM of CONSTRUCTIONAL ENGINEERS in India REQUIRE a STRUCTURAL FOREMAN, age under 25, unmarried.—Reply, giving fullest details education, experience, present work and salary, to Z.Z. 450, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 8129 A

SITUATIONS WANTED

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MARINE ENGINEER (32), First Class B.O.T. Certificate, D.O. experience, SEEKS POSITION ashore. Excellent refs.—Address, P4352, The Engineer Office. P4352 B

MECH. DRAUGHTSMAN (Junior), Age 22, REQUIRES SITUATION; 4 yrs. tech. training, 2½ yrs. D.O. exp. in gen. mech. eng. Work in internal combustion engines preferred, any district.—J. E. H., 38, Hogarth-buildings, Westminster, S.W. 1. P4353 B

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LADY TRACER, Experienced, SEEKS CHANGE, London; quick and accurate, some drawing, good letterer. Salary £170. Charge of department if desired.—Address, P4342, The Engineer Office. P4342 B

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

A Large Air Survey Contract.

AIR surveying is a branch of civil aviation which has to its credit that its development on a successful commercial basis has been achieved without the aid of subsidies in any form. It is therefore particularly interesting to learn that the Aircraft Operating Company of London has received, in the face of keen international competition, a contract for the survey of Rio de Janeiro and the Federal District covering an area of 450 square miles. The area will be mapped on a large scale, the largest maps showing 63in. to the mile. This scale has not previously been used for mapping a large area from the air. By normal ground methods the survey would, it is estimated, take twelve years to complete, but using a combination of air and ground methods, the company has undertaken to finish the survey in 3½ years. The work will be carried out under the technical supervision of Colonel H. L. Crosthwait, R.E. (ret.), a director of the company and late superintendent of the Survey of India. The company has already carried out aerial survey contracts in Venezuela, British Guiana and Rhodesia, and has undertaken experimental air survey work for the British Ordnance Survey. In connection with its surveying activities, it has at present under construction a special design of aeroplane which, we learn, will differ materially from commercial transport machines of the ordinary type. This machine will be driven by two air-cooled radial engines operating geared propellers, and, carrying the normal survey load and 240 gallons of fuel, will have a ceiling of 23,000ft. At 20,000ft., it will have a cruising speed of 110 miles an hour and a range of 7½ hours. This high performance might seem to be uneconomical, but it has to be remembered that with a reliable machine of high performance the number of emergency landing grounds that have to be provided and maintained is considerably reduced.

Geophysical Surveying.

IN company with others, we attended a private meeting on Wednesday of this week at the Institution of Civil Engineers, which was organised by L. Oertling, Ltd., of London, and which was designed to spread knowledge concerning geophysical methods of surveying, of the apparatus of British manufacture available for the purpose, and of some of the results already achieved by geophysical methods in this country. The chair at the meeting was occupied by Sir John Flett, Director of the Geological Survey of Great Britain. Sir John reminded those present that various methods of geophysical surveying were available, including electric, magnetic, gravitational, the use of wireless and the use of sonic waves. Not much, he said, had so far been published on the subject in this country, but we were slowly accumulating a sound fundamental knowledge concerning it. Dr. W. E. P. McLintock, of the Geological Survey, then gave an address on the "Gravitational Survey over the Swynnerton Dyke, Staffs." The Swynnerton Dyke is an intrusion of basalt in a formation of post-Triassic age. By means of a large portable Eötvös torsion balance made by Messrs. Oertling, Dr. McLintock carried out a gravitational survey over the dyke and obtained results which were in remarkably close agreement with the facts as revealed by the surface indications. Mr. E. Lancaster-Jones, of the Science Museum, followed with a description of the new gravity gradiometer, as made by Messrs. Oertling. This gradiometer is a small-sized torsion balance working on the Eötvös principle, and is designed to be insensitive to the curvature of the earth. It is claimed to have many special applications, including the picking up in a mine of a lode that has disappeared. Captain H. Shaw, also of the Science Museum, gave an account of some field work that he and Mr. Lancaster-Jones had carried out with the gravity gradiometer in a seashore area. He stated that it had been found possible to set up five stations between tides, one reading of the gravity gradient being taken at each station. Captain W. H. Fordham concluded the meeting with an address on "The Magnetometer and its Applications in Geology and Mining."

High-speed and Transatlantic Flights.

Two recent air disasters—Flight-Lieut. Kinkead's fatal accident when attempting to establish a world's seaplane speed record, and the disappearance of Captain Hinchliffe and Miss Mackay on an east-to-west Transatlantic flight—have attracted renewed public attention to the voluntary incurring of hazardous risks in the air. Since the succession of Transatlantic disasters last year there has been growing up a strong feeling here and abroad that governmental prohibition should be imposed on such flights. Speaking last week in Birmingham, Sir Samuel Hoare, Secretary of State for Air, expressed what we may take to be the official view on the subject. He desired, he said, gravely to warn any British pilot against undertaking an east-to-west Transatlantic flight until machines of increased endurance were available. As to prohibiting such flights or imposing conditions that would be tantamount to prohibition, he said that such action on the part of the Government would not, in his view, be either wise or practicable. It would, he pointed out, be impossible to isolate Transatlantic flights, and if such flights were prohibited, it would be necessary also to prohibit adventurous attempts of every kind, by boat, motor or otherwise. Moreover, the prohibition would be futile, for a British pilot prevented by the regulations from starting from this country could make the attempt with impunity by flying to France or Ireland. High-speed trials, such as that in which Flight-Lieut. Kinkead lost his life, were in a different category. High-speed flying, he maintained, directly encouraged the advance of aeroplane and aero-engine design, and was necessary to the progress of aviation. It is announced that a fresh effort is to be made to recover for this country the world's seaplane speed record, and that a Supermarine Napier machine of the design used by Flight-Lieut. Kinkead will be employed for the purpose.

Great Eastern Train Ferries.

AT the fifth annual general meeting of Great Eastern Train Ferries, held in London on Friday of last week, March 23rd, the chairman, Lord Daryngton, reported that the Harwich–Zeebrugge train ferry services were becoming increasingly popular, and that the profits for the previous twelve months amounted to £46,776, as compared with £27,251 in the previous year. The import traffic carried by the ferries had increased from 133,000 tons to 138,000 tons, and the export traffic from 12,000 tons to 18,000 tons. By far the most important item in the export traffic was, he said, the carriage of finished rolling stock. He drew the special attention of pottery and machinery manufacturers in this country to the special facilities which the ferries offered for the export of their products. On the import side an important item was the carriage of 1523 tons of acid in the owners' tank wagons, specially adapted for running over both continental and British railways. The ferry, he pointed out, was the only service which could offer facilities for the carriage of tank wagons. He concluded by stating that practically all those who had adopted the ferry as a means of transport for their goods had been impressed by its usefulness and efficiency.

A Marine Turbine Building Record.

IN the course of a speech made at the recent launch of the geared turbine passenger steamer the "Duke of Rothesay," Mr. Maurice E. Denny stated that the vessel was a notable one because it was the hundredth ship built by his firm for propulsion by steam turbines. Mr. Denny recalled the fact that dealing only with merchant ships, and excepting the five which were sunk or otherwise destroyed during the war, all the vessels, including the 1901 pioneer turbine steamer "King Edward," were still in service. The "Duke of Rothesay" is a 360ft. ship, with a beam of 53ft., and a depth of 18ft. 5in. She has a gross tonnage of 3794 and a trial speed of 21 knots. There is accommodation on the ship for 308 saloon and 104 steerage passengers. The propelling machinery consists of a twin-screw arrangement of single-reduction geared turbines of the Parsons type, and steam is raised at 225 lb. pressure in six Babcock and Wilcox water-tube boilers which are designed to work under forced draught on the closed stokehold principle. The sister ship, the "Duke of Argyll," is now being fitted out at Dumbarton, and the "Duke of Lancaster" has recently undergone very successful trials before being placed on the Heysham–Belfast service of the London, Midland and Scottish Railway Company. Mr. Denny paid tribute to the great value of the experimental tank in connection with the design of these and other ships. It had been possible to guarantee the L.M.S. company a trial speed of 21 knots at a certain horse-power and to attain that speed on about 100 S.H.P. less than the figure which had been named.

Sixty-eight Years a Shipbuilder.

WITH his retirement from the chairmanship of Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, Sir George Burton Hunter brings to a conclusion a period of sixty-eight years spent in the building of ships. Sir George was born at Sunderland in 1845, and at the age of fifteen he began his apprenticeship in the shipyard of W. Pile, Hay and Co. at Sunderland. Subsequently he spent two years on the Clyde with Robert Napier and Sons. In 1874 he founded with Mr. S. P. Austin the shipbuilding firm of Austin and Hunter. In 1880 the partnership was dissolved and Mr. Hunter became principal partner in C. S. Swan and Hunter, of Wallsend, which firm later became that from which he is now retiring. Since he first entered a shipyard in 1860 Sir George has seen very remarkable developments in naval architecture. When he began his apprenticeship wooden ships were just passing away and were being replaced by composite vessels with frames of iron, skins of wood and copper bottoms. Later all-iron ships were built and in 1879–80 he saw the introduction of steel as a shipbuilding material. In the days of iron shipbuilding he recalls the primitive rule-of-thumb constructional work which was characteristic of the times, the small amount of machinery employed in the yards, the limited number of draughtsmen engaged in the drawing-office, and the restriction in the sizes of iron plates. With the introduction of steel the weight of plates that could be used without incurrng special charges rose from 9 cwt. to 40 cwt. In the whole of his career Sir George has built only two sailing vessels, but the steamers for which he has been responsible have increased in size from 300 or 500 tons up to the Mauretania's 36,000 tons. Sir George is to remain a director of the company, and will be succeeded as chairman by Mr. T. E. Thirlaway.

The Zeppelin Airship LZ 127.

WHILE attention in this country has been concentrated on the construction of the two 5,000,000 cubic foot airships now being built at Cardington and Howden, strenuous efforts have been made in Germany to complete the Zeppelin airship LZ 127 in time to forestall the British vessels on the Atlantic flight. The German vessel is considerably smaller than the Air Ministry's or the Airship Guarantee Company's craft. It has a capacity of 3,700,000 cubic feet, and will provide accommodation for twenty passengers and a crew of twenty, in addition to a large amount of mail and other cargo. The Airship Guarantee Company's vessel, it may be noted, with an extra 1,300,000 cubic feet of capacity, will carry 100 passengers and a crew of forty-three, in addition to 10 tons of freight. From the technical point of view, chief interest in the new German airship resides in the fact that the main supply of fuel will be gaseous. The gas to be used has not, so far as we are aware, yet been disclosed, but its properties have been indicated with sufficient clearness to enable us to say that it has the same density as air and a calorific value of about 1450 B.Th.U. per cubic foot. In our issue of July 30th, 1926, on the strength of information which we confirmed by communicating with Dr. Eckener, of the Zeppelin Airship Company, we discussed the significance of the use of gaseous in place of liquid fuel on airships. We are aware that in certain quarters the conclusions we arrived at on that occasion were not wholly accepted—although on what grounds they were open to criticism we were never informed. The fact that after nearly two years the idea of using gaseous fuel of the kind discussed is still a feature of the new Zeppelin airship, ought, we think, to count for something. It at least suggests that renewed study should be given to the subject.

Rapid Shipbuilding on the North-East Coast.

IN the course of the past week two notable instances of rapid shipbuilding on the North-East Coast came under our notice. The first concerns the building of a series of 2400-ton steamers by Swan, Hunter and Wigham Richardson, Ltd., for the Great Lakes service of Paterson Steam Ships, Ltd., of Fort William, Ontario. Two vessels, the "Cartierdoc" and "Lavaldoc," underwent successful trials on Thursday, March 22nd, and on the following day a third ship, the "Mondoc," proceeded on trials. The "Novadoc" was also launched on Friday, March 23rd, and this week the "Newbrundoc" will take the water. All these vessels have been launched within a little over two months, and all will be ready to set out for their destination in a few weeks' time. We understand that the rapid completion of these vessels and of their steam propelling machinery has given great satisfaction to the owners. At Hebburn-on-Tyne on Tuesday last, March 27th, there was launched from the yard of Palmer's Shipbuilding Company, Ltd., the oil tanker "Catatumbo" for the Venezuela Gulf Oil Refining Company, Ltd., which vessel will be the largest among Palmer ships in the owners' fleet. At the launching ceremony Sir Joseph Isherwood, representing the owners, said that the ship had been launched in fifty-two days from the turning of the first frame. The builders, he said, had the machinery ready and, barring unforeseen occurrences, the new tanker would be ready to sail early in April.

Twenty Years of Strikes.

IN the course of his address to the annual general meeting of the shareholders of his company held on March 26th, Sir Robert Hadfield, discussing peace in industry, gave some interesting statistics regarding labour disputes in this country during the period from 1908 to 1927 inclusive. During these twenty years, he said, there had been something like 16,000 separate disputes, involving a total of 16,364,000 workpeople directly and 2,154,000 indirectly, or an aggregate of 18,518,000 workers. The number of working days lost as a result of these disputes was 461 million. That figure, he said, was equivalent to 300 years' operation of the Hadfield works with their staff of 5000 workpeople. If, he proceeded, each of the firm's employees produced on the average goods having a selling value of about £400 per annum, then the value of the products which could have been made during those 461 million lost working days could be assessed at £615,000,000. That sum, he stated, represented the value of products which the world was ready to absorb, and which would have increased the trade turnover, added to the circulation of money, and contributed to the general prosperity. One-third of the loss, or £205,000,000, he added, was concentrated into the year 1926.

The Static Balancing of Rotors.

By Professor B. P. HAIGH, D.Sc., Royal Naval College, Greenwich.

No. II (*Conclusion*).*

THE relative importance of static and dynamic unbalance may often be judged by the degrees of vibration that the two actions produce at different parts of structures, *e.g.*, along the length of a ship. A ship, like any long beam, vibrates in different natural modes, as sketched in Fig. 8, and each mode has its own natural frequency that depends on the mass and elasticity of the structure. A rotor that is statically unbalanced will transmit vibration along the structure in any great degree, only if two conditions are fulfilled—(1) the speed of rotation approaches the critical frequency of the ship in the mode considered, and (2) the rotor is situated far enough from a "node," so that the unbalanced forces can do work on the structure when it moves through a certain amplitude. Thus a rotor that is statically unbalanced would not cause vibration in the cases sketched if it were situated at any of the "nodes" marked N in the diagram.

On the other hand, a rotor that is dynamically unbalanced will transmit vibration along the ship only if it is situated far enough from the "anti-nodes"—defined as the points at which the slope of the flexed profile of vibration is zero. These points are marked A N in the diagram. To obtain a fair comparison between the relative importance of static and dynamic vibration in this respect it is desirable to compare a statically unbalanced rotor situated at an anti-node with a dynamically unbalanced rotor situated at a node.

For equal degrees of vibration in the two cases

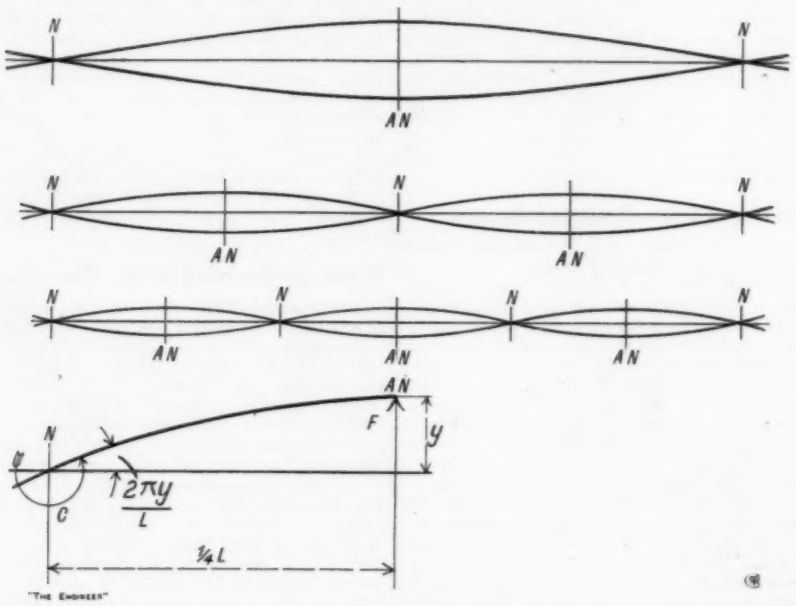

FIG. 8

equal quantities of work must be done on the structure by the unbalanced force and by the unbalanced couple. These quantities of work are proportional to the deflection and slope respectively at the points at which the rotor is placed. For equal vibration, therefore,

(Unbalanced couple) × (slope at node) = (unbalanced force) × (deflection at anti-node).

For purposes of comparison it will suffice to assume that the curve of profile is approximately a sine wave, with wave length L. The greatest slope is then $(2\pi y/L)$ radians, where y is the greatest deflection. If the unbalanced couple is denoted by C and the unbalanced force by F, the energy equation becomes

$$C\,(2\pi y/L) = F \times y,$$

whence it follows that the degrees of vibration in the two cases are equal when

$$C = F\,(L/2\pi).$$

As the wave length L is very great in ordinary ships, commonly over 200ft. in any large liner, it follows that a very great unbalanced couple is required to produce the same vibration as a small unbalanced force. If the arm of the couple is 4ft. when the wave length is 200ft., the two forces that constitute the dynamically unbalanced couple would have to be eight times as great as the single force of static unbalance. It follows that dynamic unbalance may often be regarded as of minor importance in turbines. The contrary view, that dynamic unbalance may provoke important vibration in ship structures, is doubtlessly based on experience with multi-cylinder reciprocating engines in which the arm of the couple may be much longer than in a turbine rotor or electric motor. In multi-cylinder engines, whether steam or internal combustion, dynamic balance is important and the frames should be stout enough to ensure that the inevitable lack of internal balance causes no undue bending. In turbines, gearing and screw propellers the arm of the possible couple is so much less that dynamic unbalance loses its importance.

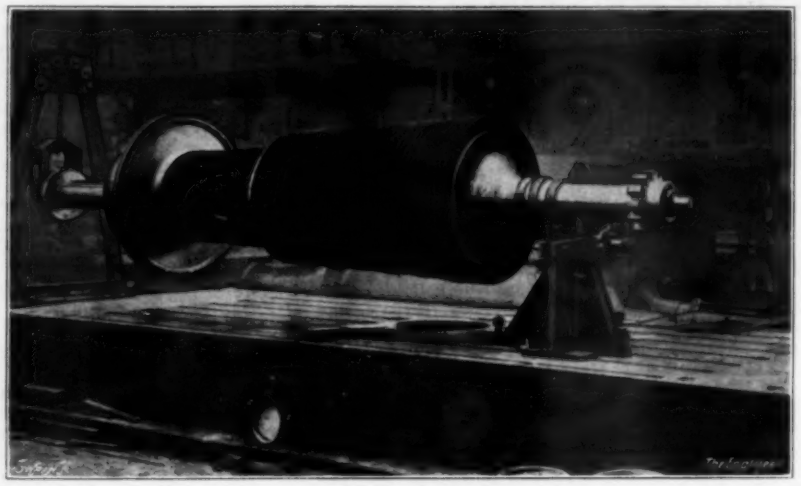

FIG. 9—SEVEN-TON ROTOR IN BALANCING MACHINE

In such circumstances it appears that more attention might with advantage be given to accurate static balancing and, in particular, to methods that are more definite than the current process of rolling the rotor on its bearings supported on horizontal rails.

The rolling process, although simple in idea, suffers from theoretical difficulties that render it troublesome in practice. In the first place, the rails should be rigid. If they are not quite horizontal the error may be allowed for; but if they are not rigid the variable error is more perplexing to the operator. In the second place, the rolling action of the journal on the rail is subject to perceptible friction. The load indents the surfaces in the same manner as in the well-known Herbert "pendulum" hardness test, although in less degree, and an indefinite torque is required to move even a perfectly balanced rotor. This small torque might be less objectionable if it were not that the rolling body, when balanced, is in neutral equilibrium. In this connection it may be borne in mind that a chemical balance in neutral equilibrium would also be very inconvenient in use. It is only when such a balance has a slight degree of stability—so that it swings to and fro with a definite slow period—that it is capable of making weighings with the degree of accuracy we are accustomed to expect. The operator using a chemical balance judges the state of balance by comparing the swings in opposite directions, not by adding weights until motion starts in one direction or the other, as does the balancing operator using rails.

It appears that these petty difficulties may often give the operator, using rails, a false impression that a rotor is balanced when actually it is still far out of balance. In a notable instance the bearings of a long solid forged high-pressure marine impulse reaction turbine rotor gave continuous trouble in service, and in two years the owners replaced no fewer than twenty sets of bearings, some at the forward end and others at the after end of the turbine. As the rotor was long and had been balanced "carefully by rolling on rails," it was believed for some time that the trouble was due to lack of dynamic balance. Eventually, when the owners decided to have the rotor balanced on a Martin static balancing machine, it was found to be statically 2 foot-pounds out of balance. This was corrected and the turbine refitted, and the machinery then ran without perceptible vibration or wear on the bearings of either turbine or gearing. Three other vessels of the same company, with turbines balanced in the same manner—statically—have all given equally good service and collectively have run over 450,000 miles without appreciable wear on the bearings. Fig. 9 shows one of these long rotors in process of being balanced.

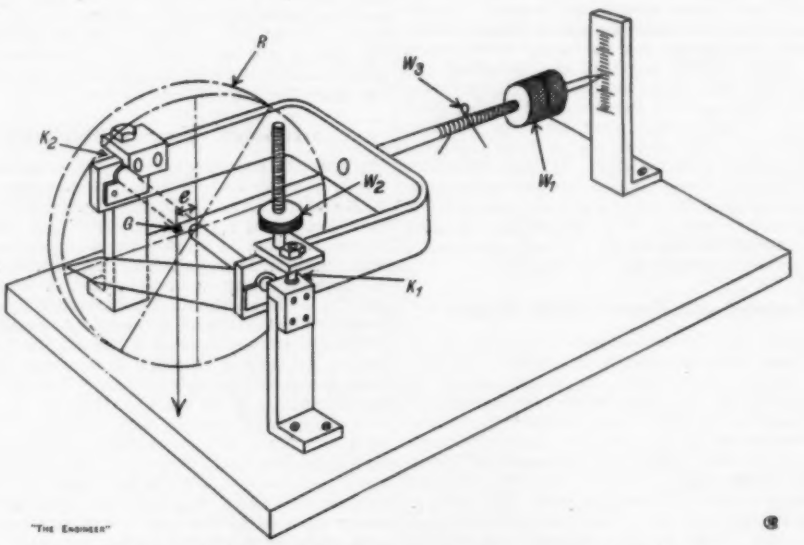

FIG. 10—DIAGRAM OF MARTIN STATIC BALANCING MACHINE

The table in the next column shows the unbalance moments found and corresponding corrections of the centre of gravity made in several of these rotors.

It is considered that lack of static balance may be

* No. I. appeared March 23rd.

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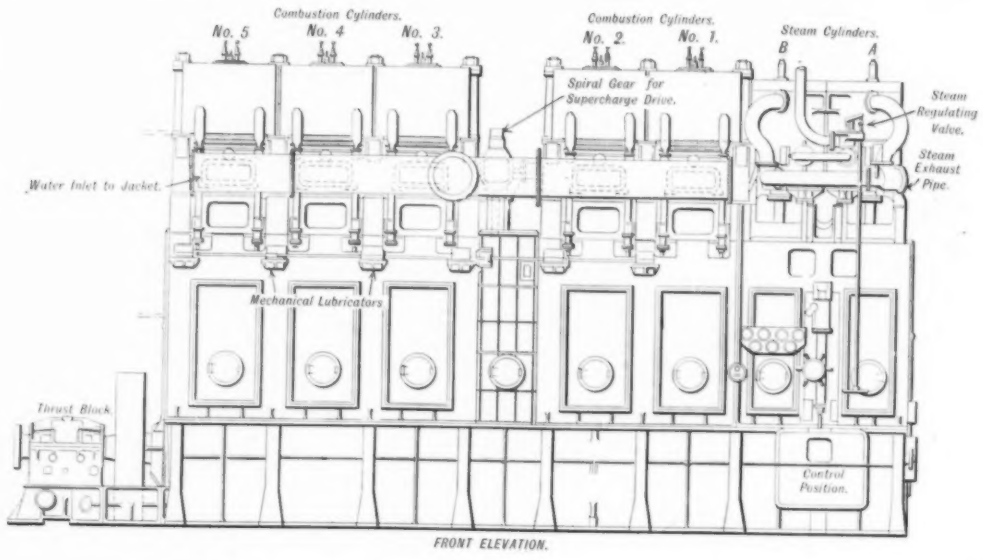
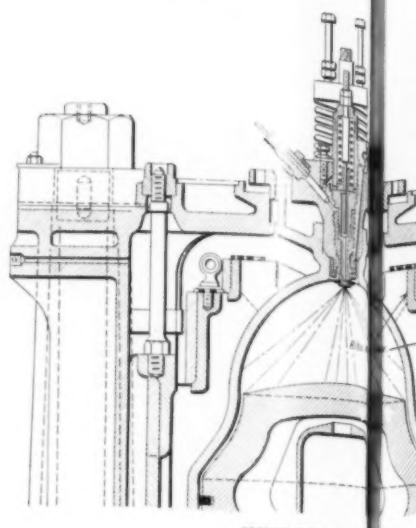
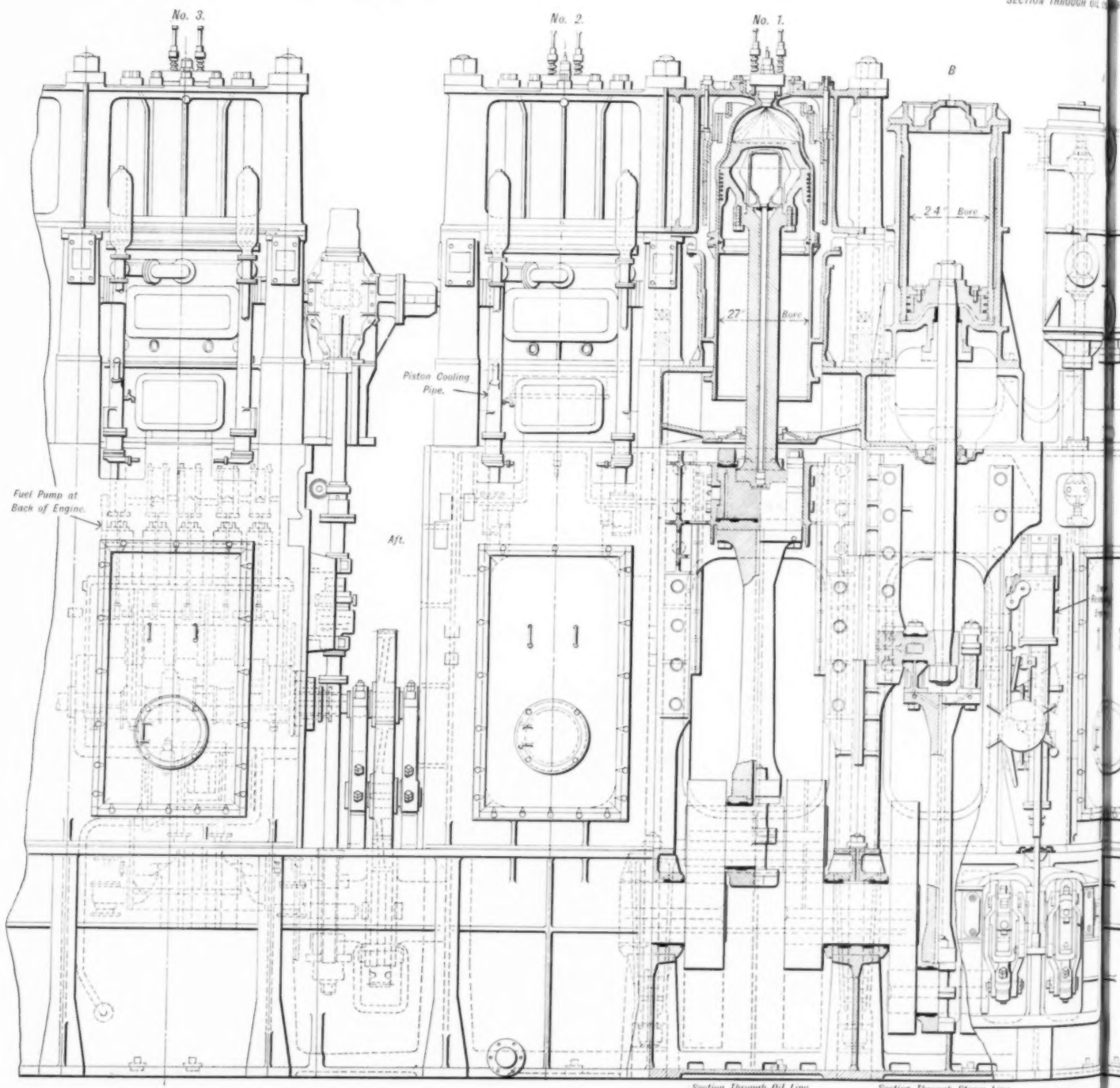


FRONT ELEVATION.



SECTION THROUGH OIL [illegible] HEAD.



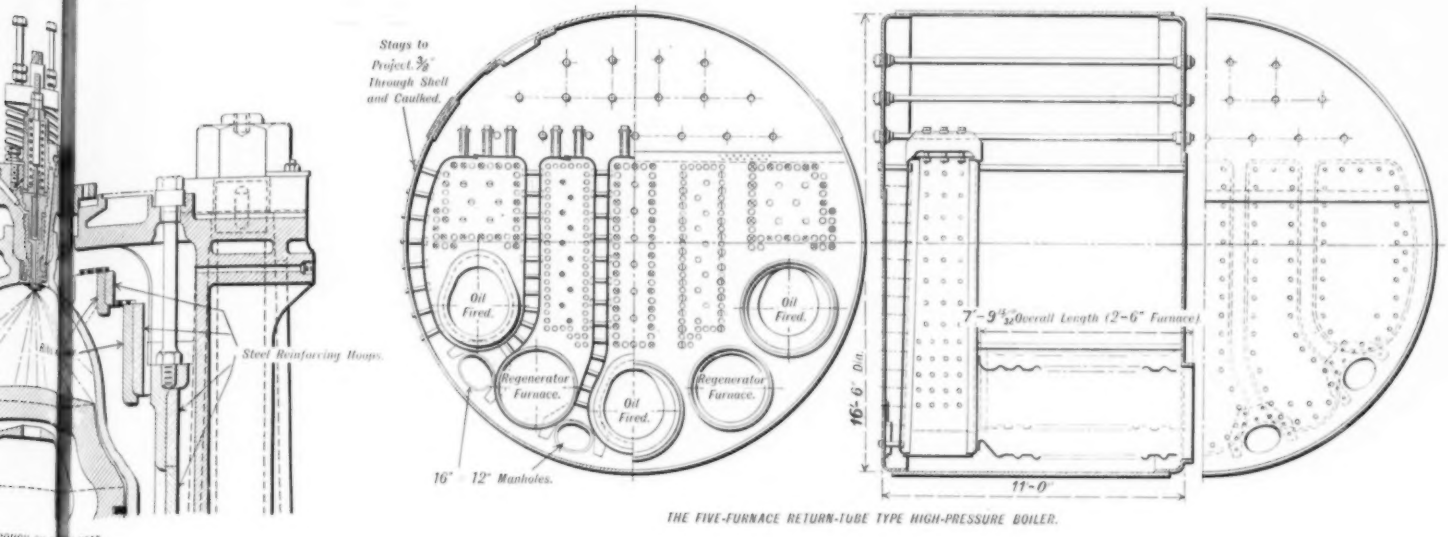
Section Through Oil Line.

Section Through Steam Line.

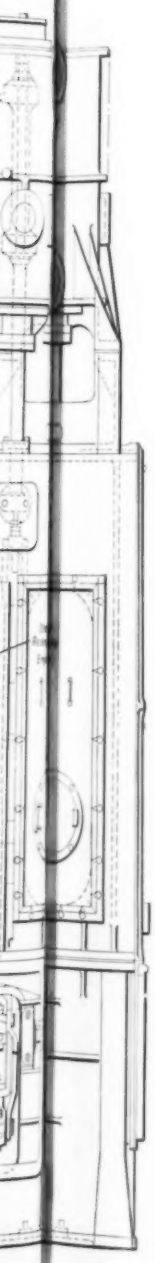
"THE ENGINEER"

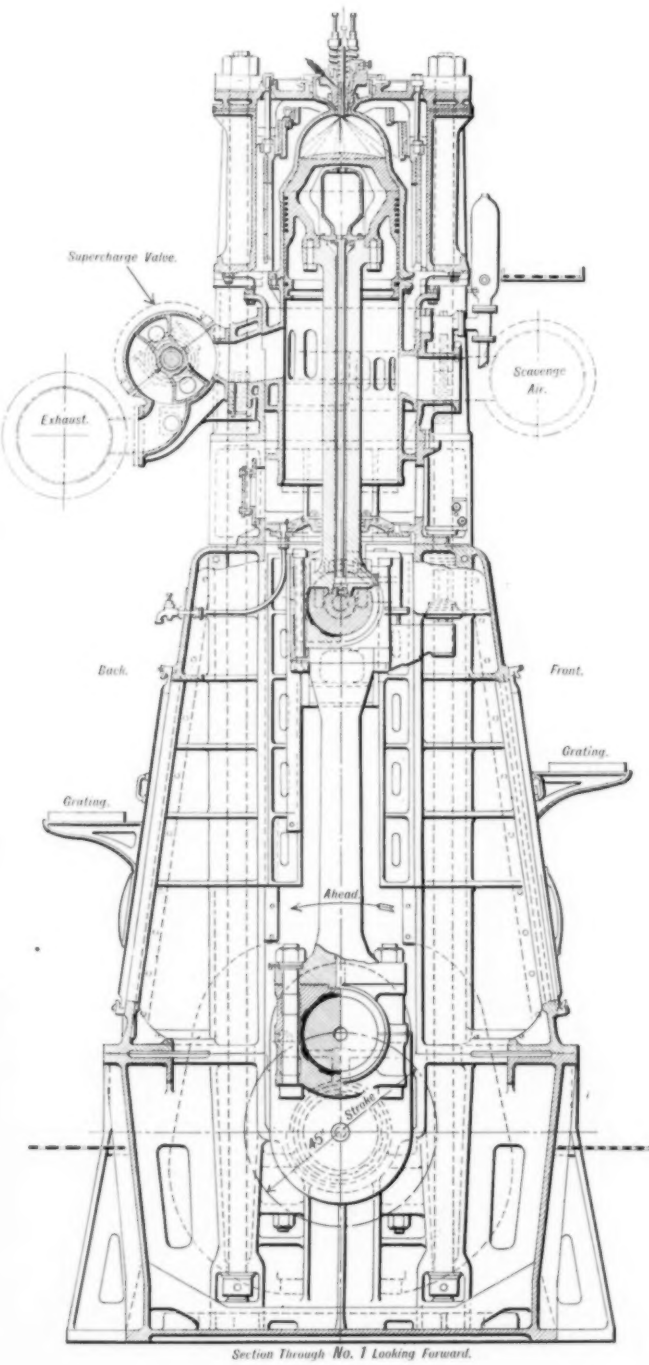
E FOR THE MOTOR VESSEL EURYBATES

GINEERING COMPANY, LTD., GREENOCK, ENGINEERS

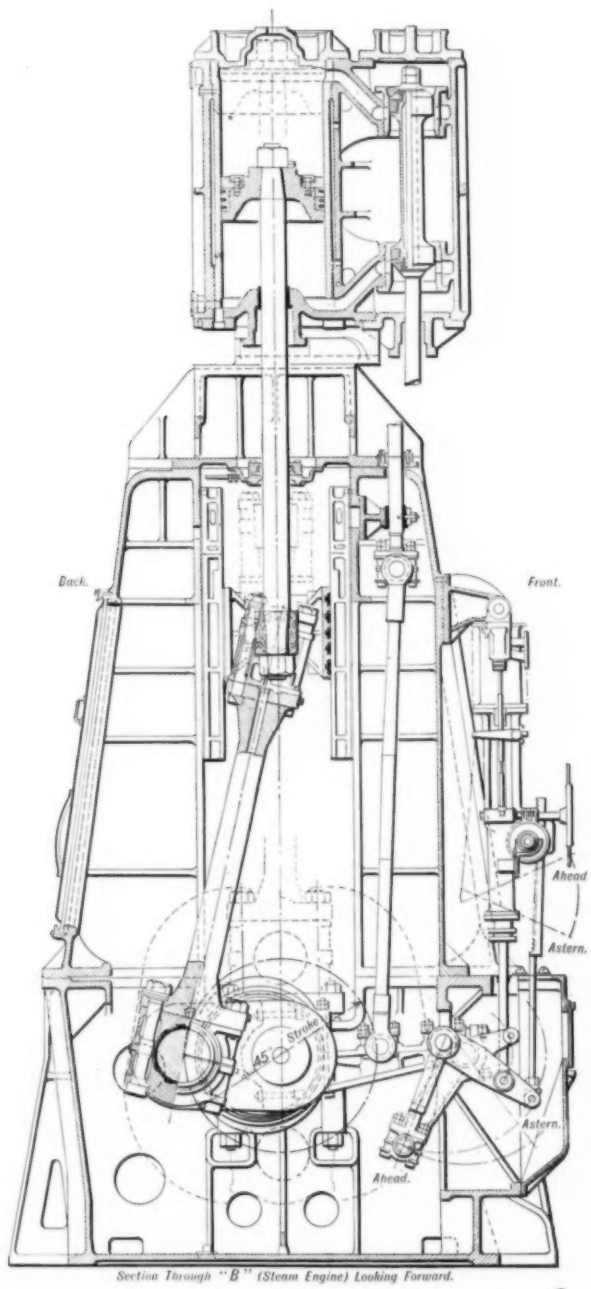


THE FIVE-FURNACE RETURN-TUBE TYPE HIGH-PRESSURE BOILER.





Section Through No. 1 Looking Forward.



Section Through "B" (Steam Engine) Looking Forward.

UNIV. OF MICH.

an important cause of some of the difficulties that have been experienced with gear teeth; and that the wheel the teeth of which suffer most is not necessarily the one that is out of balance. Resonant vibration of one member may originate from forces transmitted from another. For example, suppose that a massive gear wheel is mounted in fairly rigid bearings and that the frequency of natural vibration of the combination is, say, 3000 per minute, and therefore far above the highest speed at which the gear wheel will ever run, say, 500 revolutions per minute. If the wheel is driven by a turbine that is statically unbalanced by a pinion with 5 : 1 ratio—so that the turbine runs up to 2500 revolutions highest speed—we may expect that the wheel will vibrate more and more as the speed rises, even though the wheel itself may be ideally balanced. Although 500 is so much less than 3000 that any unbalance in the wheel would be hardly magnified at all, any vibration coming from the turbine would be greatly magnified about 2500, and the critical speed would be reached at 3000.

Unbalance Moments and Corrections.

Rotors balanced.	Weight, tons.	Out-of balance moment found, inch-pounds.	Weight removed (dependent upon the radius), lb.	Corresponding correction of centre of gravity of rotor, in.
H.P. turbine rotor	2·636	3·26	·459	·00055
L.P. rotor ..	5·285	5·03	·507	·00042
H.P. rotor ..	6·685	31·25	2·976	·0021
L.P. rotor ..	4·038	11·5	·538	·00057
H.P. rotor ..	6·674	18·8	1·76	·0012
L.P. rotor ..	9·061	29·6	1·53	·0014
H.P. rotor ..	7·087	9·37	3·07	·00059
L.P. rotor ..	9·058	51·1	2·43	·0025

It has been shown theoretically in the first part of this article that in cases in which such magnifications of small effects are the immediate cause of trouble, static unbalance is magnified at the first critical speed and dynamic unbalance only at a higher. Except in those special and exceptional circumstances in which machinery works at speeds above the first critical and approaches the second, it is to improvement of static balancing—and not dynamic—that we must look for the means of remedy. As the current method of balancing by rolling the rotor on rails does not appear sufficiently sensitive or reliable for many practical purposes, it is proposed to consider in some detail the principle and mode of operation of the Martin static balancing machine. For many of the particulars given the author is indebted to Mr. W. Hamilton Martin.

In its essential principle, the Martin static balancing machine may be regarded as a weighing machine arranged to measure, not the total weight of the rotor, but the moment of its weight about the axis of rotation. In this respect the balancing machine is the very antithesis of the ordinary "platform" weighing machine, which indicates, by intention, exactly the same reading no matter where the load may stand upon its platform. In the balancing machine, the readings give no measure of the total weight, but they serve to show where the centre of gravity lies. The idea is represented in Fig. 10, in which R represents the rotor to be balanced, with its centre of gravity G at a distance ϵ from the centre line of the bearings. In the model illustrated, these bearings rest on V-shaped supports, both of which are carried on a single frame that acts as a lever, and is supported on knife-edges K_1 K_2—two small balls in this case ensuring constant alignment. The lever frame carries two large weights W_1 and W_2, and a smaller weight W_3, all of which can be adjusted in position as indicated in the sketch. The first weight W_1 is moved to and fro horizontally until the rotor and frame together are approximately balanced on the knife-edges. The second weight W_2 is then moved to and fro vertically until it is found that the combination swings with a suitably slow period of oscillation, it is important that the lever frame should swing with a reasonable period, for if it be too sluggish in its motion the machine loses its advantage over the older method of rolling the rotor on rails. When adjustments have been made so that the lever frame swings nicely, the third weight W_3 is brought into use to make the final adjustment, and it is at this stage that the actual process of balancing begins. From this stage onwards the weights W_1 and W_2 are left untouched, and only the third and smallest weight is adjusted as required to complete the balance.

The method of deducing the position of the centre of gravity is briefly as follows:—The rotor is turned on its V supports to a number of successive positions, so that a radial reference line O R—Fig. 11—stands, during successive weighings, at different angles θ to the vertical plane. For each angle θ the system is found to balance with W_3 in a different position x. The simple mathematical relation between the quantities is:—

$$x W_3 = C + We \sin (A + \theta),$$

where W is the total weight of the rotor, and A is the angle that defines the direction of the centre of gravity relatively to the radial plane that contains the reference line O R. The term C is a constant, the value of which depends simply on what may be the exact position of the larger weight W_1. If the lever-frame cannot be brought to a state of balance

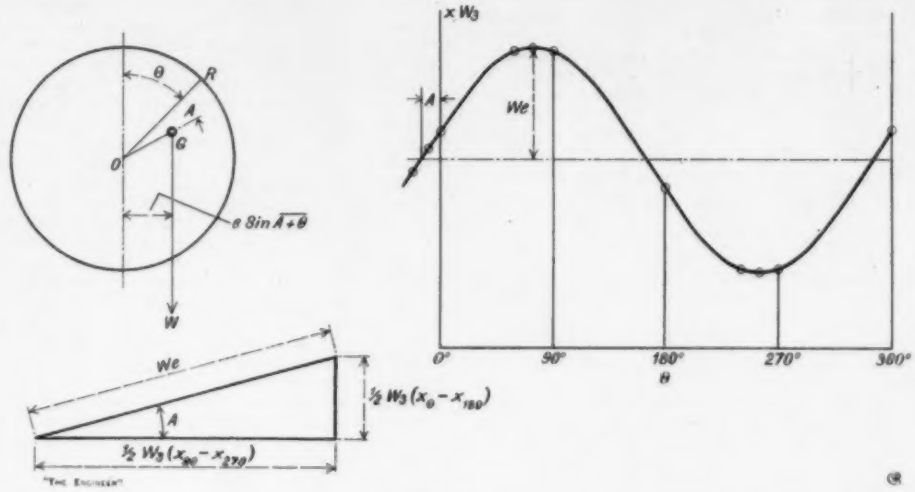


FIG. 11

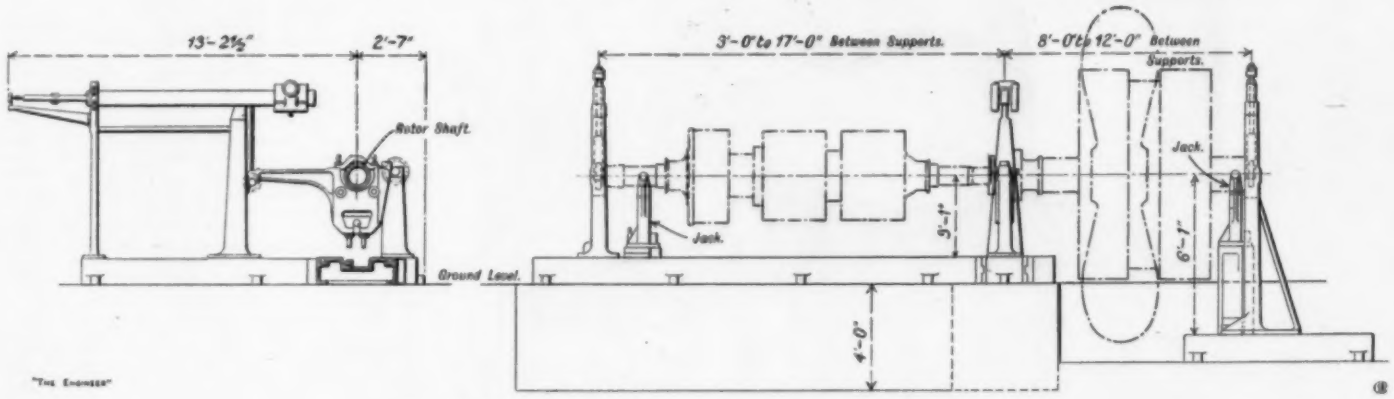


FIG. 12—ARRANGEMENT OF MARTIN ROTOR BALANCING MACHINE

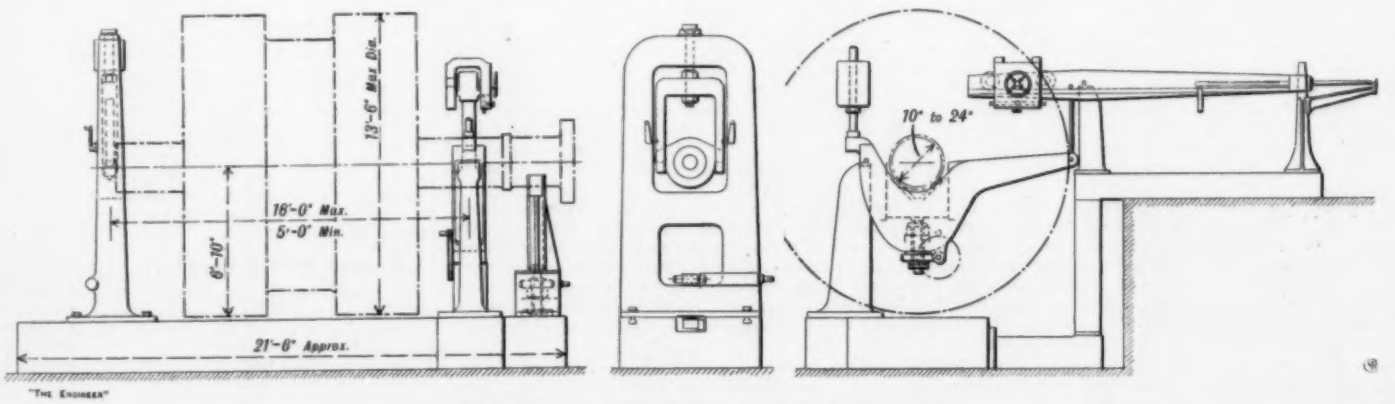


FIG. 13—BALANCING MACHINE FOR ROTORS UP TO 120 TONS

To analyse the readings x and θ, that is, to find the static unbalance in magnitude and direction, the usual "shop" procedure is as follows:—The readings x are plotted on a base of θ—Fig. 11—and are found to lie on a sine curve as sketched. The curve is drawn through the successive points, and the value of W e is

proportional to half the height of the wave, thus

$$W \cdot e \cdot = \tfrac{1}{2} W_3 (x \max - x \min).$$

Moreover, the value of A is read off from the point at which the wave cuts the horizontal line drawn at mid-height across the wave.

For extreme accuracy, it may be desirable to take a large number of readings at different angles; but no great number is necessary, and three observations are theoretically sufficient to eliminate C and determine the values of W *e* and A. Perhaps the simplest procedure is to take only four observations with θ equal to 0 deg., 90 deg., 180 deg. and 270 deg. The values of W *e* and A are then deduced as follows: Since

$$x_0 W_3 = C + W \cdot e \cdot \text{Sin } (A + O) \text{ and } x_{180} W_3 = C + W e \text{ Sin } (A + 180)$$

it follows that $(x_0 - x_{180}) W_3 = 2 W \cdot e \cdot \text{Sin } A$

and likewise $(x_{90} - x_{270}) W_3 = 2 W \cdot e \cdot \text{Cos } A$

hence $\text{Tan } A = (x_0 - x_{180}) / (x_{90} - x_{270})$

and $W \cdot e = \tfrac{1}{2} W_3 \sqrt{(x_0 - x_{180})^2 - (x_{90} - x_{270})^2}$

Or graphically, the operator may mark off, as in Fig. 11, two lines at right angles with lengths proportional to

$$W_3 (x_0 - x_{180}) \text{ and } W_3 (x_{90} - x_{270})$$

and may then measure off the hypotenuse of the triangle, proportional to W *e*, as well as the angle A, the tangent of which is equal to the ratio between the two sides that have been marked off.

As the success of the machine depends largely on the sensitivity of the knife-edges, these knife-edges are made of hardened steel, and in the manner that has long been used with success in machines for testing materials. To those who may not actually have handled testing machines of large size, the sensitivity that can be attained and permanently maintained by high-class knife-edges may be a surprise. In the case of a balancing machine designed for rotors up to 15 tons in weight, and constructed by Joshua Buckton and Co., Ltd., of Well House Foundry, Leeds, it has been found possible to detect a change of position of the centre of gravity as small as $^1/_{20000}$in., and in a very small balancing machine constructed by Barr and Stroud, Ltd., of Glasgow, on the lines of Fig. 10, for the purpose of balancing the rotors of small gyroscopes up to 6 lb. in weight, the change in position that can be detected is much smaller than in the larger type.

In general, this degree of sensitivity considerably exceeds the requirements of practice, but is advantageous, because it facilitates operations in different ways. In particular, it allows of quite small rotors being accurately balanced in machines that are designed primarily to deal with much heavier rotors. In precisely the same way, in a large lever-type testing machine for materials, tests on small pieces can be carried out with all necessary accuracy, when the knife-edges are reliable, although the machine may be capable of testing pieces ten times as strong.

The handling of the machine is as simple as weighing and needs no special skill. It is sometimes desirable to warn balancing operators not to waste time in making tests with undue accuracy. The weighings can often be made with all desirable accuracy and much more speedily by lowering the adjusting weight W_2—Fig. 10—so that the beam swings with a quicker period of oscillation. In other words, the sensitivity of the machine can be adjusted to suit circumstances.

The general lay-out of the Martin balancing machine is arranged to suit work of widely variable sizes, and is illustrated in Fig. 12. View I. gives a front elevation of the compound lever system, which, in practice, is often, but not always, employed in lieu of the simple lever frame represented in the earlier diagrammatic sketch. In the case illustrated a triple lever system is used. View II. is a side elevation, and shows the relative positions of the weighing system and the special support which in practice replaces one side of the lever frame shown in the diagrammatic sketch. While one end of the rotor is supported on V guides on the weighing lever, the other end is supported on a ball bearing that swings on a small ball pivot some distance above the shaft. The same view shows the positions of the two jacks that are used for lowering and adjusting the rotor on the machine. While the lever weighing system remains in a fixed position for all jobs, the positions of the other parts are adjusted to and fro to suit the dimensions of successive jobs. Long rotors of moderate diameter may be placed on one side of the weighing system, and short wheels of large diameter may be placed on the other. It is important to note that the accurate operation of the machine does not depend on the rigidity of the supports and foundations, and that no very massive or rigid foundations are required. For this reason the frame may be made in separate parts with a gap to accommodate large wheels. In this respect the machine differs widely from many dynamic balancing machines, in which the oscillating frames—often subject to severe live-load stresses—should be theoretically rigid as well as light, if possible, and in which massive foundations are essential to maintain the pivoting axes free from vibration. Fig. 13 shows a machine for dealing with rotors up to 120 tons, such as ship's stabiliser rotors, hydraulic turbine runners, fly-wheel alternators, &c. Fig. 14 and Figs. 15 and 16, page 350, give a good idea of the general design of the machine as it appears in service, with different classes of work, turbine rotors and propellers and the like.

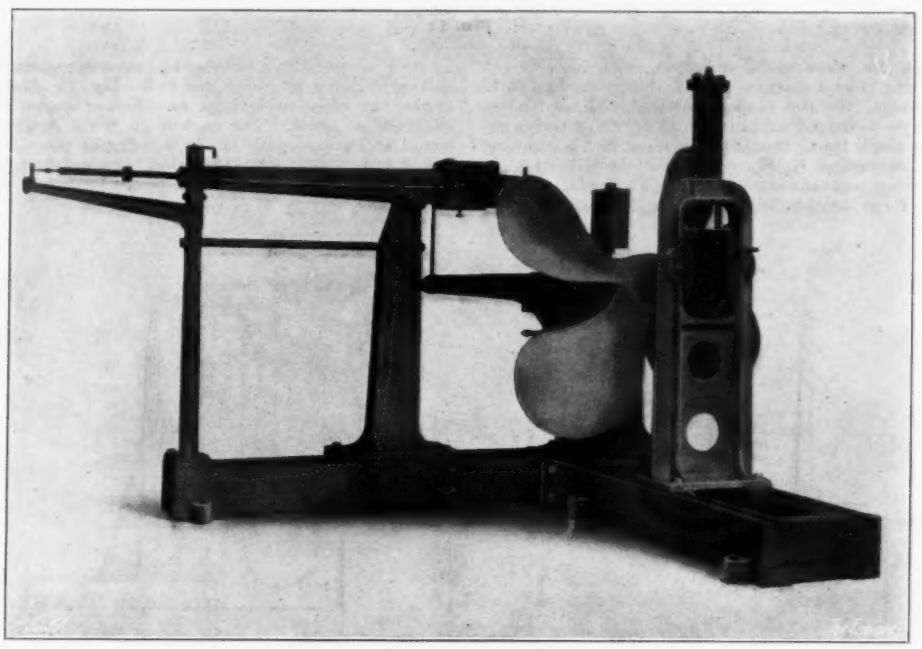


FIG. 14—3-TON MARTIN ROTOR BALANCING MACHINE

It is understood that different sizes are made for rotors from 1 lb. up to as much as 120 tons or more; but any one size covers a wide range of work. Thus the 15-ton machine illustrated can deal with rotors weighing not less than ¼ ton upwards, detecting an out-of-balance moment as small as ¼ inch-pound and locating the direction to within a degree. The 3-ton machine, which, in Fig. 14, is shown balancing a propeller, will indicate unbalance moments of 1 ounce-inch in rotors from ¼ cwt. upwards.

The variety of work that can be balanced in such machines, with beneficial results in service appears to be almost unlimited. Particularly in electrical and in marine work where high speeds are so very desirable from economic points of view, accurate static balancing appears to offer considerable advantages at slight expense that is amply repaid in other savings.

Canadian Engineering News.

(From our own Correspondent.)

The Electro-Chemical Industries.

ELECTRO-CHEMICAL and electro-metallurgical activities in Canada have shown substantial growth since the war, according to a report issued recently by Professor H. M. Tory, President of the National Research Council, and the Univresity of Alberta. It is estimated that the total chemical industry production for 1926 was about 10 per cent. above that for 1925, while 1927 showed a further increase in many lines. "Of these industries," says Dr. Tory in his report, "the most rapid advances are being made in the group of heavy chemicals, which heads the list in the value of its products, and particularly in that division of this group which comprises electro-chemical products and their derivatives—calcium carbide, calcium cyanamide, sodium cyanide, artificial graphite, phosphorus, caustic soda, bleaching powder and chlorine. Canada's present per capita hydro-electric power development is second only to that of Norway, while her aggregate development, some 5,000,000 horse-power, is second only to that of the United States. When it is remembered that the present turbine installation is only about 1 per cent. of the total water power available, the possibilities of the further growth of these industries becomes evident. The researches of Matheson and associates have resulted in the establishment of thriving industries at Shawinigan Falls, Quebec, while Niagara Falls has become the centre of a large number of electro-chemical and electro-metallurgical industries. It is interesting to note the close relation between the metallurgical and chemical industries, and the growth of the latter to utilise by-products of the former. For some years the Consolidated Mining and Smelting Company at Trail, B.C., has been manufacturing sulphuric acid for its own use from zinc roaster gases, and thence hydro-fluosilicic acid for its lead refinery. With much gas still going to waste, however, a larger market was sought for sulphuric acid, and a search was begun for phosphate rock. This was successful, and it is anticipated that acid phosphate will shortly be produced on a considerable scale. Similarly, the Mond Nickel Company, at Coniston, Ontario, has been anxious to make use of the sulphurous gases going to waste at its nickel smelter. Recently a contact sulphuric acid plant has been built to utilise a part of the gas from the basic converters, and cheap acid of high grade is now being manufactured for the Eastern market from raw material which was at one time a public nuisance. One of the important factors in the rapid development which is now under way is the Aluminium Company of Canada. This company has for years produced aluminium on a moderate scale in its works at Shawinigan Falls, Quebec, but has recently begun operations at Arvida, Quebec, in the Lake St. John district, which may in course of time rival those of Trail for pre-eminence in the non-ferrous metallurgical field. Another important metallurgical development is anticipated within the next few years at The Pas, Manitoba, where a large deposit of copper-gold-zinc ore has for some time been known to exist, and where research is expected shortly to complete the solution of a difficult metallurgical problem. Should this materialise, it will be the first important metallurgical development in the prairie provinces of Canada."

The St. Lawrence Development Plan.

The National Advisory Committee on the proposed navigation and power developments of the St. Lawrence waterway above Montreal, involving an international agreement and expenditure totalling upwards of 300,000,000 dollars—£60,000,000—has submitted its report to the Government. Besides providing a new shipping channel, the scheme is expected to furnish a potential new hydro-electric supply of upwards of 400,000,000 horse-power.

The recommendations of the Committee have not been made public pending consideration by the Government, and the presentation of its policy to Parliament, but it is understood that the Committee endorses the economic feasability of the whole project with a 27ft. channel to Montreal and the initiation of negotiations with the United States for the construction of the international section. At the same time it is understood that it favours the prior construction of the lower section wholly within Canadian territory and the boundaries of the Province of Quebec, pending an agreement in respect of the international section. As the Province of Quebec favours development by private enterprise rather than public ownership, it is suggested that private capital now desirous of developing the lower section of the St. Lawrence waterway might be permitted to proceed on the understanding that any canal or navigation works should be handed over to the Government with the developing interests retaining the hydro-power rights for the exclusive use of Canadian consumers. In any event, the consummation of the whole project would be a matter of ten or twelve years, and it is unlikely that any actual beginning would be made on the international section of the waterway before 1930.

Aeroplane Engines.

The production of aero-engines will be begun in Ottawa, Ontario, within a few weeks by the Armstrong-Siddeley Motors, Ltd., operating in association with the Ottawa Car Manufacturing Company. The Armstrong-Siddeley Company will be the first in Canada actually to build its own motors. Decision to start operations in Ottawa has come at the end of two years' investigation on the part of the company, which has had both its managing director and its production manager in the Dominion for some time past, but the entire proceedings were kept secret until quite recently.

Remedial Works at Niagara.

The Special International Niagara Board has issued an interim report in which plans are recommended for the preservation of the scenic beauty of the Horseshoe Falls at Niagara Falls. The Board, after thorough investigation, finds that the United States and Canadian flanks of the Horseshoe are already practically bare. The type of construction considered by the Board as best suited to re-water properly the flanks of the Horseshoe is a combination of excavations and submerged weirs carried from the shores near the flanks into the adjacent main currents only far enough to accomplish the desired deflection of water to the flanks. The initial remedial works proposed consist of the removal of exposed shoals, in conjunction with the construction of submerged weirs lying diagonally and irregularly across the current, with incidental and co-ordinated excavation designed to deflect water from the heavy currents to the north and south of the central shoal, to distribute the water over the floor of the shelf adjacent to both shore lines, and to the crest of the falls, and to merge into the general effect of the existing cascades.

The Shannon Power Plant.

No. II. (*conclusion*).*

THE Escher-Wyss unit is very similar to the Voith machines, both in size and construction; in fact, several of the larger parts are interchangeable. Drawings of the Escher-Wyss machine are given in Figs. 11 to 13. The diameter of the entry to the runner is 2·3 m., or 7·5ft., and the outlet diameter is 4 m., or 13ft. There are fifteen runner blades, composed of 30 mm. sheet steel, which are cast in the cast steel boss and rim. Special rings fitted on the boss and periphery of the runner can readily be changed in the event of undue wear and loss of pressure. There are twenty-four moving cast steel guide vanes, which are supported on spindles connected to the governor ring. The diameter of the spiral casing at the point of entry is 4·6 m., or 15ft., and the diameter increases to 6 m., or 19·7ft. The maximum diameter of the spiral casing itself is 13·5 m.—44·3ft. The water discharged from the runner first passes through a lined shaft, and then into the concrete draught tube elbow, which has a horizontal length of 18 m. (60ft.), and at the discharge end it is 13 m. (42·6ft.) wide and 5 m. (16·4ft.) high. In order to ensure proper stream line flow in the bend, the elbow is provided with a dividing wall. For packing the hydraulic stuffing-box there is a small impeller type pump, which delivers the leakage water back to the seal, and as an additional precaution against leakage, Olivite packing is provided, as shown in the drawing, Fig. 11. In the event of a high water level in the tail-race giving rise to additional leakage, a special pump is brought into action to deal with this leakage. The turbine shaft bearing is lubricated by means of a small gear pump installed on the lower oil container. The bearing housing, which is exceptionally strong, also provides a bearing for the governor ring which is connected to the two servo-motors by means of the usual rods. The servo-motors are provided with oil by means of oil pumping sets installed on the turbine gallery. Another oil pump on the bearing provides the necessary circulating oil for the step bearing. The governor controls are on the generator floor, and it is possible to control the complete unit at this level. The oil pump units on the turbine floor first delivers the oil into a pressure chamber, from which it is supplied to the servo-motors, the governor oil pump units being so designed that in the event of one failing the other two are capable of operating the governor. One of the oil pumping sets, together with the pressure chamber, is shown in Fig. 14. Each of the pumps is driven by a 60 horse-power motor, running at a speed of 965 revolutions per minute, and each is capable of delivering 410 litres of oil per minute, against a head of 250 m. A drawing of the thrust bearing fitted to the Escher-Wyss turbine is shown in Fig. 13. The total axial thrust, including the weight of the rotating parts, is 502 tons, and it is believed that this is the greatest load that has ever had to be taken by a thrust bearing. The heat due to friction is taken care of by a separate oil cooler on the turbine floor, and also by cooling coils built into the casing, as shown.

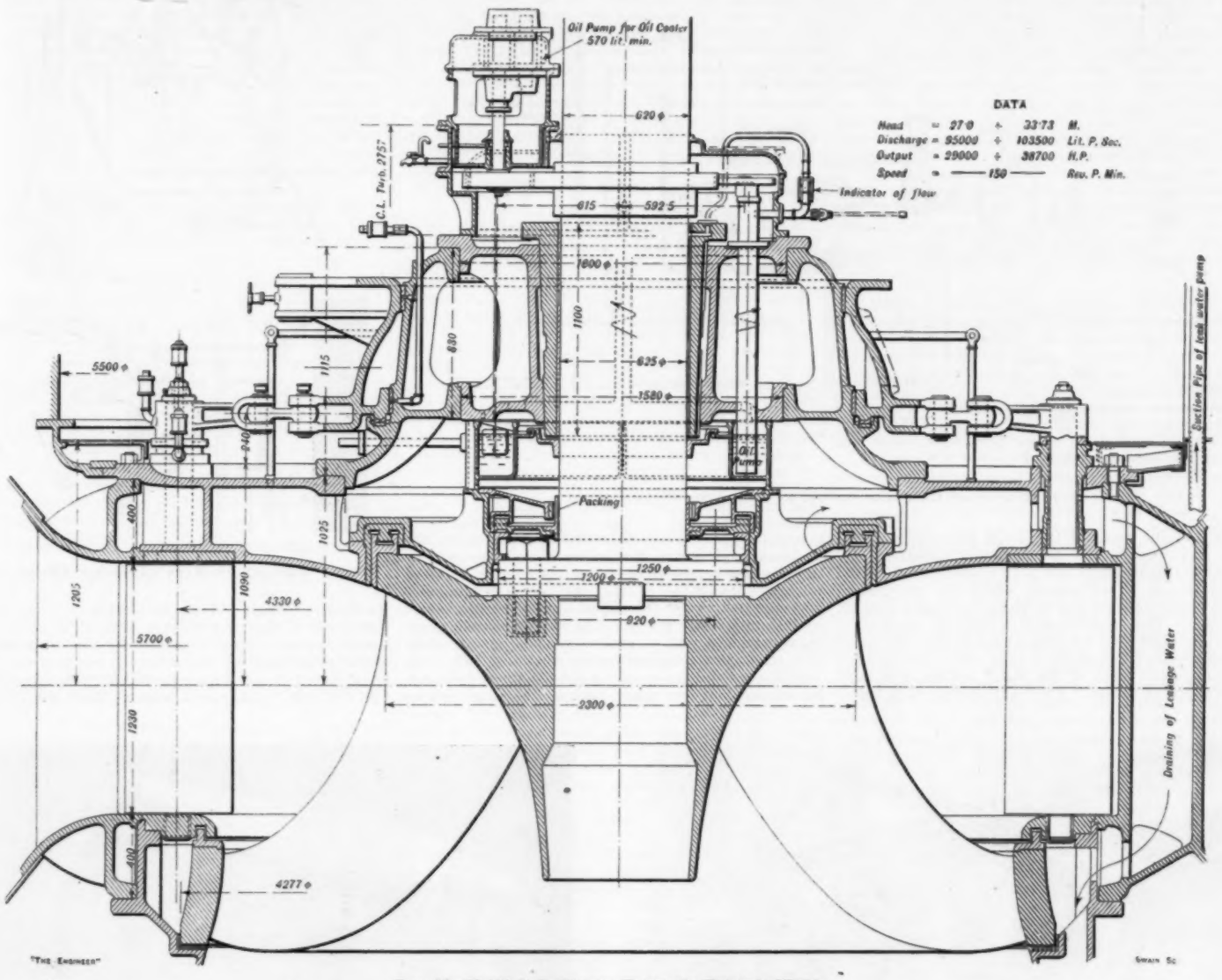


FIG. 11—38,600 H.P. WATER TURBINE—ESCHER-WYSS

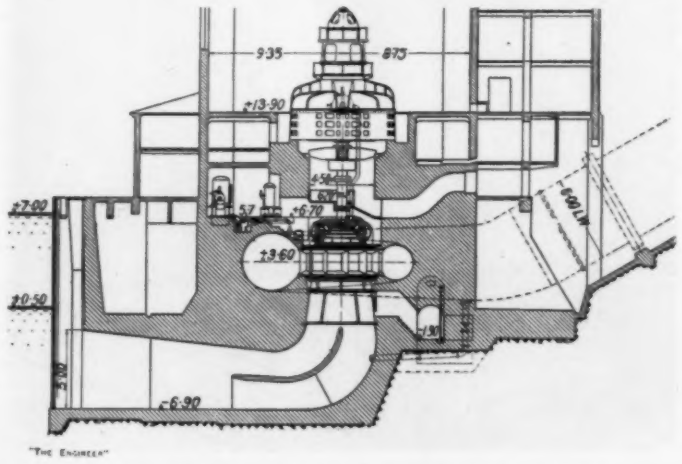


FIG. 12—WATER TURBINE AND GENERATOR—ESCHER-WYSS

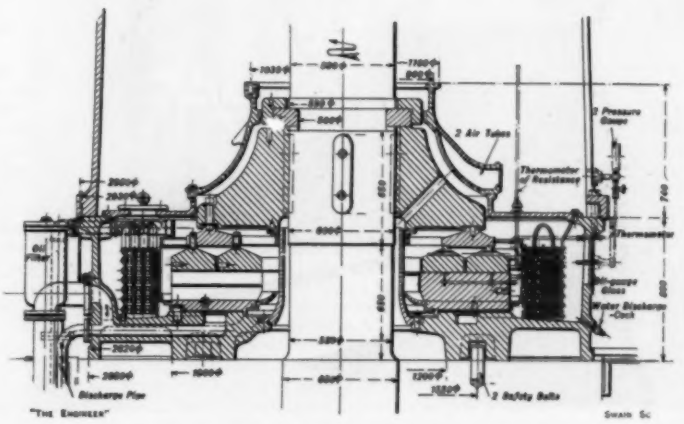


FIG. 13—THRUST BEARING—ESCHER-WYSS

* No. I. appeared March 23rd.

The outside diameter of the bearing surface is 1950 mm.

The gate cleaning apparatus—see Figs. 15 to 17—for the intake building is being supplied by Escher, Wyss and Co. Electric motors are employed for shifting the apparatus along the rails and for operating the sledge and bucket. The machine will be shifted on rails arranged on the platform above the screen. After the shifting gear has been locked, the comb is lowered by means of the sledge, which slides on the rods of the screen. The sledge is then lifted again and the teeth of the comb pass between the rods and remove the accumulated material. By means of this machine it will be possible to clean the whole length of the screen, which for the partial development scheme will be 45 m., or 148ft., long, in 4½ hours. The cleaning will be done in sections of 1·6 m., or 5·2ft. In the event of the teeth of the comb meeting with an obstruction that offers considerable resistance, the teeth of the comb are automatically tripped out of action. A self-aligning carriage below the gate cleaning apparatus receives the material, which is quickly and conveniently discharged into the waste channel.

Each of the three vertical enclosed Siemens-Schuckert generators for the partial development scheme will be rated at 30,000 kVA, with cos $\varphi = 0{\cdot}7$. They will run at a speed of 150 revolutions per minute and will generate three-phase current at a pressure of 10·5 kV, which will be raised to 38 kV and 110 kV as described in our article appearing in our issue of December 2nd of last year. Each generator will be coupled to a 440-volt exciter mounted on the top of the machine in the ordinary way. An auxiliary exciter with an output of 7 kW coupled to the main shaft will supply the field current for the main exciter, thus permitting the main generator to be regulated by controlling a current of small magnitude. Air for cooling the machines will be drawn from outside the building, and during the winter the hot air will be used for heating the power-house. Air will be required for each generator at the rate of approximately 40 cubic metres per second, at a pressure equivalent to 110 mm. water gauge. The weight of each generator complete with its exciter will be approximately 370 tons, the complete rotor weighing 190 tons. The stators and rotors of all the machines will each be delivered in four parts. All the bearings will be fitted with resistance thermometers and the temperatures will be indicated on a panel near the generator. The temperature of the stator windings and that of the air entering and leaving the generators will be indicated in the control room.

The main switches for the generators and the isolating switches will be placed in the upstream part of the generating station, and the machine switches will be operated on the remote control system from a control room adjacent to the turbine-room. By means of signal lamps and other devices the attendants in the remote control room will be able to give instructions to the turbine-room staff. From the control-room it will also be possible to control the transformers, and instruments will be provided to enable the attendants to ascertain the temperature of the transformer oil, whilst alarms will give warning in the event of this temperature becoming excessive. For the full development scheme there will be six 30,000-kVA generators and five 30,000-kVA transformers, with a ratio of 10,500/110,000 volts, and two 8000-kVA transformers with a ratio of 10,500/38,000 volts.

During the period of the partial development scheme two generators will work on the 10·5-kV bus-bars, whilst the third generator will supply current through a

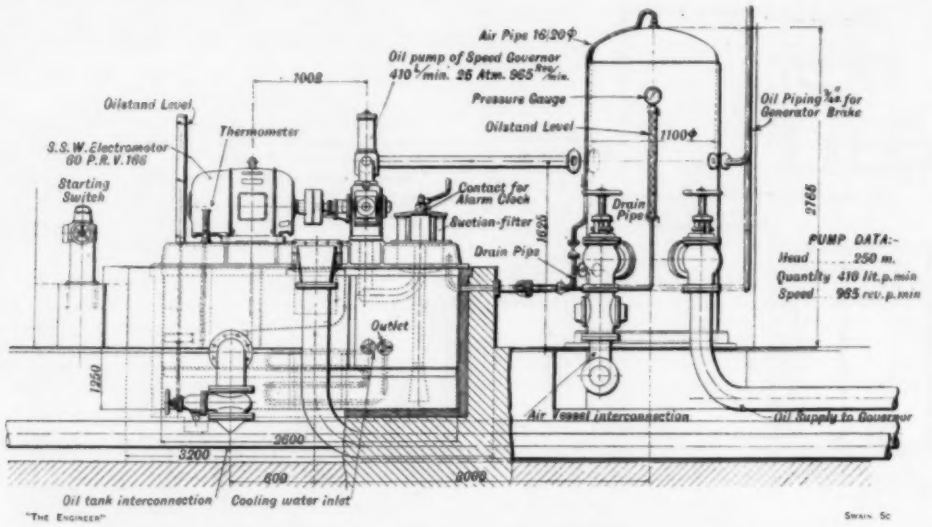


FIG. 14—OIL PUMP UNIT AND PRESSURE CHAMBER—ESCHER-WYSS

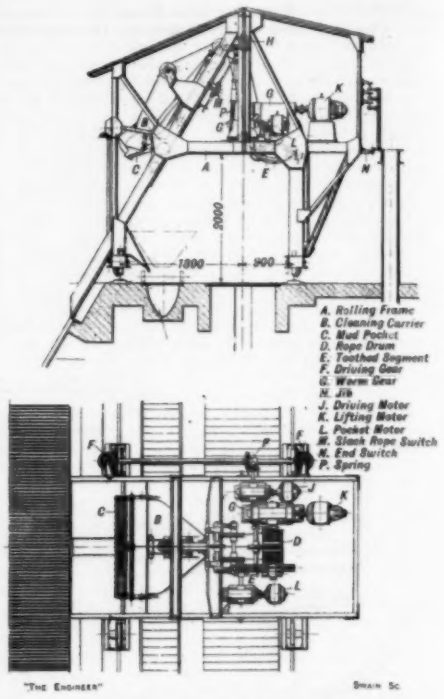
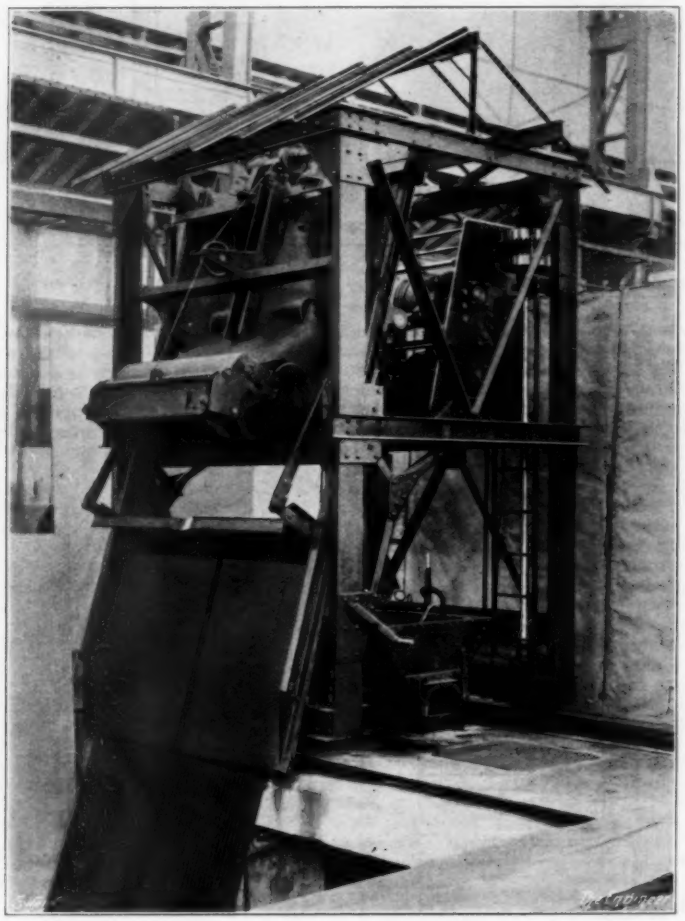


FIG. 17—DETAILS OF GATE CLEANING APPARATUS



FIGS. 15 AND 16—GATE CLEANING APPARATUS—ESCHER-WYSS

30,000-kV transformer directly to the 110-kV bus-bars. The 10·5-kV switchgear will be installed in a building adjacent to the power-house on the upstream side. The 38-kV switch house will be situated at right angles to the centre line of the power-house, and its bus-bars will be connected with the 10·5-kV plant by means of cables leading to the two 8000-kVA transformers with a ratio of 10·5/38 kV. Five 38-kV overhead lines will branch off from this part of the power station to feed the network. All switches associated with the 38-kV apparatus will be controlled in a similar manner to those for the 10·5-kV plant from the control-room by means of lifting magnets and signalling devices. The 110-kV equipment will be of the outdoor type, and will be situated on the right of the downstream side of the tail race. The 30,000-kVA 10·5/110-kV transformers will be connected to the outdoor equipment by means of overhead lines, and one double and one single 110-kV line will feed the 110-kV network. All switches associated with this 110-kV gear will be operated from the control-room.

The power station will have all the usual apartments, such as offices, workshops, battery and converter rooms for the station supply, oil stores, &c.

Institution of Naval Architects.

No. I.

THE spring meeting of the Institution of Naval Architects was held in the rooms of the Royal Society of Arts, John-street, Adelphi, London, on Wednesday, Thursday, and Friday, March 28th, 29th, and 30th. There was a large attendance at the opening meeting on Wednesday morning, March 28th, when the retiring President, His Grace the Duke of Northumberland, presided during the first part of the proceedings.

The Secretary read the annual report of the Council.

ANNUAL REPORT OF THE COUNCIL FOR 1927.

Although the conditions in the shipbuilding and marine engineering industries, owing to the recent revival in trade and shipping, have shown signs of slight improvement since the last annual report of the Council, the prolonged inactivity of the last few years has had a marked effect upon the normal expansion in the membership of the Institution.

The total numbers on the roll of the Institution show a slight decline in the past six years, but this is principally due to the smaller number of students.

The audited statement of accounts for the past year is appended to the report, and shows a satisfactory position at the end of the year.

His Grace the Duke of Northumberland having intimated his desire not to seek nomination as President for 1928, the Council unanimously agreed to invite Admiral of the Fleet Lord Wester Wemyss to succeed his Grace as President. His Grace the Duke of Montrose, C.B., C.V.O., and Engineer Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S., have been elected Honorary Vice-presidents in recognition of their long and distinguished services on the Council. Sir Charles E. Ellis, G.B.E., K.C.B., having served as hon. treasurer since 1909, has tendered his resignation, and Mr. Francis Henderson has been nominated for election to fill the vacancy. The hearty thanks of the Council and members are due to Sir Charles Ellis for his most valuable services as treasurer of the Institution for the past eighteen years.

The National Tank continues to carry out valuable research work under the guidance of the Advisory Committee, and its efforts are deserving of cordial support from the shipping and shipbuilding interests of the country. The Council trust that, notwithstanding trade depression, members of the Institution will use their best endeavours to obtain from any firms with which they may be connected the promise of further and more liberal support to the research fund of the Tank.

Two premiums have been awarded for papers contributed to the "Transactions" in 1927, viz.:—Mr. Hugh J. R. Biles, B.Sc., for his paper, "Notes on the Effect of Wind on Power and Speed"; Mr. W. C. S. Wigley, M.A., for his paper, "Ship Wave Resistance—A Comparison of Mathematical Theory with Experimental Results: Part II."

The scheme for the award of National Certificates in Naval Architecture is now in operation, and is working satisfactorily, both in England and Wales and also in Scotland, under the two Committees which were set up last year. The first award of certificates was made in 1927, and it is hoped to stimulate the interest of candidates by the offer of prizes from a fund established by his Grace the Duke of Northumberland.

A bronze bust of the late Sir Philip Watts, K.C.B., F.R.S., which was subscribed for by a number of his friends, has been presented to the Institution by the Committee which raised the fund. The formal presentation will be made at the annual general meetings.

The number of entries for the scholarships during the past year has been below the average, mainly owing to the unsatisfactory conditions of the shipbuilding industry, which have discouraged apprentices from competing for the scholarships offered.

The Duke of Northumberland then said that his next pleasant duty was to move the election of Admiral of the Fleet Lord Wester Wemyss as President, but before doing so he wished, as that was his last appearance in the chair, to say a few words of farewell. He need hardly say how greatly he regretted that he should be saying good-bye to the Institution, because he looked back with the greatest pleasure upon the memories of the last seven years. From the personal point of view they had had many very great advantages and had conferred many great benefits upon him. He had had opportunities of making a great many friends, and although in the future he would not have the opportunity of meeting them in his official capacity as President, he hoped those friendships would continue and that he would be able to continue them in a less formal capacity. He desired to say a word of hearty appreciation of the relations which had always existed between the Council and himself, because he was fully aware of the great help and support which the Council had always given him. In saying that, he felt a special debt of gratitude to those veterans Sir John Biles and Sir Archibald Denny. An expression of gratitude was also due to the Secretary, Mr. Dana, for the cordial support he had always given him. During his period of office the arrangements made for the visits of the Institution abroad and in this country had often been most difficult and complicated, but in every case those visits had been most ably conducted. He congratulated the Institution upon having gained Lord Wester Wemyss' consent to accept office as President. Not only had he held the highest naval commands, both in peace and in war, but he had also held the office of First Sea Lord during two years of the most critical period of the war, when the German submarines were making the most serious inroads into our shipping, and no testimony could be too great to the debt of gratitude which the country owed to Lord Wemyss for his services. He could not imagine anybody who was better qualified than Lord Wester Wemyss, and he had the greatest pleasure in proposing that he be elected President of the Institution of Naval Architects.

The proposal was carried with acclamation.

Admiral of the Fleet Lord Wester Wemyss, in taking the chair, first expressed his thanks for the honour done him in electing him President, and he thanked the Duke of Northumberland for the extremely kind way in which he had introduced him. There was no need to refer to his own lack of knowledge of naval architecture, but in spite of that drawback it seemed to be not inappropriate that the presidential office should be filled by a man of his profession, since seamen, whatever branch of the service they were in, were those who were, more than anybody else, personally concerned with the advance of the science of naval architecture. But it was by no means only those who went down to the sea in ships who profited by the researches of the naval architect. Indeed, there was nobody who was not affected by them, on account of the influence they had upon trade. The wealth of a nation was usually reckoned by its natural resources and by its raw materials, but the value of those raw materials was really derived from the fact that they could be exported and transported to all those parts of the world in which they were necessarily required, and it was that movement of commodities, which was called trade, which brought profit to everybody who touched it—the original owner, the transporters, the shippers, the freighters, the brokers, the insurers, and eventually the vendors. It was that trade which was really the life-blood of nations, and anything that could facilitate or forward that trade in any way was a matter of universal benefit, and naval architecture could do more in that direction than anything else. The Ancients, of course, with their primitive ideas of the possibilities of navigation and their primitive means of pursuing it, regarded the sea as an obstacle which interfered with communication between themselves and other people overseas, but to-day we knew better. We knew that the seas were the main highways of the world, along which there was always a perpetual and ever-increasing body of trade flowing backwards and forwards, and that we were able to make such good use of those main high roads of the sea was due to naval architecture.

That, continued the President, was the broad aspect of the way in which naval architecture presented itself to him, and that being the case, he need hardly say how proud he was to find himself President of an institution whose object and aim was to further and do all it could for the improvement of this great beneficent science. Owing to the fact that so much of the trade of the world was seaborne, it was perhaps natural that the state of that great national staple industry with which naval architecture was so intimately bound up, viz., shipbuilding, should be regarded as an index of the state of trade of the country, and if that were so—as he believed it to be—then there were reasons to hope that the dreadful depression from which we had been suffering so long in shipbuilding might be nearing its end, because he saw that whereas at the end of 1926 there were only some 760,000 gross tons of construction, there were to-day over 1,500,000. That was satisfactory as far as it went, and especially so because some of it was for foreign orders, and it was perfectly evident how necessary it was to get foreign orders to be able to export and balance our budget.

Before, however, we allowed ourselves to regard that as an indication that the slump was over, we ought to find the causes, if there were any causes, for the amelioration of the shipbuilding trade. It might be that it was due to the wise step which the masters and men had taken to get together to see whether the cost of production could be lowered. It might be that the shipmasters, having put off for a long time giving new orders whilst prices were so enormously high, had thought the time had come when they were obliged to make replacements of their fleets; but whatever the real reason was, there must be many factors, and he himself could not see that we were justified in putting great hopes for the amelioration of trade on those facts, unless they were accompanied by a real national economy, because for the expansion of trade, capital was required. Capital had fled to a great extent during the war. He was no financier, but common sense told him that the only way that we could rebuild our capital was by living within our income—*i.e.*, by national economy. That fact had been dinned into our ears for several years, but when one looked round it was impossible to see very much result from this sermon on economy which was always being preached, whether it be national or whether it be personal.

The trades that were in such a flourishing condition were mostly luxury and protected trades, and not those trades which were really the producing trades of the country, and he did not see how non-protected producing trades could be expected to flourish until some step was taken which would lighten the burden, both of taxation and of rates. He knew something of the way in which these dreadful burdens applied to another staple trade with which shipbuilding was intimately bound up, viz., the coal trade, and he was absolutely certain that the one thing wanted was that the House of Commons, which was the guardian of the national purse, must take the matter of national economy in hand and insist on economy. Until that was done he did not think—although he knew little about it—that we were justified in any great hopes of an expansion of trade. That sounded a rather depressing statement for him to make in his first address as President, but, after all, the truth as one saw it was better that mere pleasantnesses which one did not believe in.

A paper entitled "The Present Position of the Question of Fuel for Ships," by Sir John H. Biles was then read. It will be found printed in an abridged form on page 355 of this issue.

Engineer Vice-Admiral Sir Robert Dixon opened the discussion, and, after expressing his congratulations to Sir John Biles upon the paper, examined the figures he had given, showing the gross tonnage of new vessels launched up to June 30th in the last three years. In 1925, he said, the ratio of steam tonnage to motor vessel tonnage was approximately 20 : 6. In 1926, when apparently the salvation of the mercantile marine was considered to lie in the motor vessel, the ratio of steam to motor vessel tonnage had fallen to 7 : 6; and in 1927 the ratio had risen to 9 : 6. He wondered, therefore, whether the faith of the shipowner in the motor vessel was on the wane. Perhaps some of the shipowners present would give their views on the subject. The next point of interest was the fact that after many years the mercantile marine was following in the footsteps of the Royal Navy and adopting water-tube boilers. It appeared to him that that was a step in the right direction, but it must be remembered that when the water-tube boiler was used, greater care was required in maintenance, and he, personally, was of opinion that the use of distilled water was essentially for make-up feed. The case of the "King George V." would give point to his remarks. Sir John Biles had made reference to the high-pressure installation which was fitted in that ship by Sir Charles Parsons and Messrs. Denny, and they were to be congratulated upon the results of their enterprise. The consumption results were extremely good, but he (Sir Robert Dixon) wondered how much of the economy which undoubtedly had been effected was due to high-pressure steam, how much to the very high superheat, and how much to the air preheating. It had been found that the economy of the "Nelson"—the new battleship—at high power was practically equal to that of the "King George V.," and at lower powers it was actually greater. Of course, he realised that it was not quite fair to compare the two, because the machinery installation of the "Nelson" was very much larger than that of the "King George V.," but, at the same time, it was quite possible to exaggerate the value of the high pressure; in his opinion, high pressure should be limited, and engineers should not attempt to reach on board ship the very high pressures that had been adopted in some cases in power stations ashore, *i.e.*, pressures of 1200 lb. or so, for there were very grave drawbacks to the use of such high pressures in a vessel. The Royal Navy, he hoped, would have a little more experience of the exact value of fairly high-pressure steam in the next year or two. The figures given by Sir John Biles for the purpose of comparing the costs of steam and motor vessels were inconclusive. Two of the main factors of cost were the actual running costs and the actual period during which a vessel was laid up for repairs, and it would be interesting to have some actual figures in that connection. So far as he knew, very few figures relating to the running and upkeep costs of motor vessels had been given by shipowners. The experience of the Royal Navy was that the running costs of a Diesel engine installation were considerably greater than those of a steam installation. His own view was that a really well-designed geared turbine installation, possibly with powdered fuel, could hold its own against the motor vessel or any scheme of electric propulsion.

Perhaps the most important part of the paper was that concerning the use of pulverised fuel. That was a matter of the greatest interest to the nation as a whole, because of the very depressed state of the coal trade, and if any system could be evolved by which pulverised fuel could be utilised generally afloat, it would undoubtedly assist the mining industry. The Americans had experimented, and were to be congratulated upon the results obtained in the "Mercer," but, although that vessel had successfully crossed the Atlantic twice, one could not say that the results

were altogether satisfactory. He would very much like to hear the views of a passenger on the "Mercer" as to the installation—if there had been a passenger. Undoubtedly a great deal remained to be done. The Admiralty was very much interested in the tests, but at the present stage he could not see that pulverised fuel could be utilised in the Navy. Additional weight of machinery and additional space were required, and, as every naval architect was aware, it was very difficult to provide them in a fighting ship of very limited tonnage. There would also be a lower radius of action, which was a very serious matter. Furthermore, additional staff would be required, and there were many other minor points to be considered. For instance, there was the question of the danger of storage, for undoubtedly, at present, there was a danger of an explosion when powdered fuel was used, and in a man-of-war there were already quite enough dangers of explosion without adding to them. The brand of coal to be used was another matter for consideration. He believed that in the case of the "Mercer," and in most cases, the coal used had to be picked. The ash content was very important, as was also the question of the fusibility of the ash. All these matters were such as would lend themselves to experiment, and further experiment was required in connection with the burning of powdered fuel. Sir John Biles had called attention to the fact that the Admiralty had experimented with oil fuel, but it should be pointed out that in oil fuel there was a very distinct and obvious advantage to the Navy, because it was only by the use of oil fuel that it had been able to obtain the very high powers on moderate displacement that were obtained in the modern cruiser and battleship. There was not the same advantage in the use of powdered fuel, but he did feel that, whoever took it up, experimental work was most essential.

Mr. A. SPYER (Babcock and Wilcox, Ltd.) referred to the suspicion with which the marine engineer had hitherto looked upon the water-tube boiler, and pointed to the very serious reaction on our natural resources which that attitude had brought about. Luckily, he said, the trend of opinion on the part of marine engineers to-day had obviously changed. One of the objections, as Sir Robert Dixon had said, related to the feed water and the method of treating it, but with modern designs, modern improvements in materials, and knowledge as to treatment, the opposition on that ground was very much weakened. The statement in the paper, to the effect that with coal firing it was necessary to carry extra boiler power, was a little misleading, and needed qualification. Actually, the boiler itself would do the same amount of work, no matter what fuel was used for firing, but in order to provide for the fuel-burning arrangements in connection with the particular fuel to be used, it might be necessary, and it very often was, to use a larger boiler. It should be recognised that that was on account of the fuel-burning appliances and not on account of the boiler itself. It was difficult to state definitely what increased efficiency resulted from the use of mechanical stokers. If the results of mechanical stoking were compared with the results of hand stoking in warships, where the staffs were highly trained and well disciplined, the increased efficiency resulting from the use of the former would not be very great, but in the mercantile marine, having regard to the class of labour available, a gain of from 5 to 10 per cent., or more, in boiler efficiency might result from the use of mechanical stokers. He had fitted out some thirty ships with mechanical stokers and water-tube boilers, and in all of them the results had been eminently satisfactory. A disadvantage of mechanical stokers was the limitation as to the quality of the coal which might be dealt with, but there were somewhat similar limitations when powdered coal was used. There was little doubt that if powdered fuel could be used successfully, the efficiency of the boiler side of the installation could be increased to the extent of from 2 to 4 per cent., simply because it was possible to burn the fuel and use a very high CO_2 content in the furnace, and the possibility of doing that was due largely to modern developments in the direction of water-cooled furnace walls.

The Duke of Montrose, after expressing thanks for his election as an honorary Vice-president of the Institution, said that, notwithstanding the great falling off in steam tonnage and the extraordinary increase in motor ship tonnage indicated by Sir John Biles' figures, he for one did not believe we had heard the last of steam. Sir John Biles had alluded to the "King George V." with its extraordinarily high-pressure boiler—of 550 lb.—as one of the latest examples of efficiency in steam installations, but it should be added that there was hope of obtaining still greater efficiency by the use of the Beardmore-Caporotti double-beat poppet valves with steam installations, and the very first ship fitted with those valves was at present making her maiden voyage. She was a vessel of 637 tons, and 650 I.H.P., with cylinders 13½in., 22in. and 37in., a stroke of 26in., and a boiler pressure of 200 lb. So far as her trial trips had gone, and so far as her present voyage had gone, there was definite proof of an economy of 10 per cent. on a normal installation, and there was reason to believe that if poppet valves were applied on a much larger scale—as, for instance, to a 3000 I.H.P. installation—still greater efficiencies would be obtained. Discussing the use of powdered fuel, his Grace stressed the importance of using a powdered fuel which had been through some form of low-temperature carbonisation, and expressed the view that the use of a distilled coal, as against a raw coal made all the difference between the success or failure of pulverised fuel firing. Distillation reduced the danger of spontaneous combustion, because it removed all the oil and most of the gas, and the flash-point of distilled coal was higher than that of oil. If the bunker were sealed, and inert funnel gas was drawn in, what little danger of spontaneous combustion remained in distilled coal was removed, because under those conditions the fuel could not explode. Of the other advantages of distilled coal, he mentioned that it was softer than raw coal, and therefore much easier and cheaper to pulverise; its combustion was more perfect than that of raw coal, because the ash was removed and the carbon content, therefore, was higher; it produced no clinker, tar, smoke or dirt. As to the bunkering of ships, he said that to-day we could pulverise coal so finely that 1 cubic foot of coal would occupy, after pulverisation, a space of 64 cubic feet, and coal pulverised to that fineness could be pumped on board-ship through a 6in. pipe at 40 lb. pressure per square inch at the rate of 300 tons per hour.

Mr. H. E. Yarrow gave results of the running of three boats built recently for the Canadian Pacific Steamship Company—the "Beaverburn," the "Beaverdale," and "Beaverford"—which were equipped with Yarrow water-tube boilers combined with steam turbines, and had mechanical stokers. The actual boiler efficiency obtained on the official trials at sea was 83 per cent. measured on the gross calorific value of the fuel, equivalent to about 87 per cent. on the net. The temperature of the gases at the base of the funnel was about 340 deg. Fah., the temperature of the air entering the combustion chamber, after having passed through the air heater, was about 325 deg. Fah., and the steam temperature was about 650 deg. Fah. The boiler equipment was very similar to that of an electric power station. There were instruments for recording steam flow, air flow and air pressure, as well as indicators for recording steam temperatures. Apart from the increased efficiency obtained by burning fuel mechanically, a substantial saving could be effected in the number of men in the stokehold, and such losses as were occasioned by the opening and shutting of fire-doors and the cleaning of fires were eliminated, as compared with hand firing. It certainly appeared, he said, that the old system of firing coal by hand would soon be looked upon as a thing of the past in certain classes of vessel.

Mr. R. J. Walker was in entire accord with Sir John's deduction as to the economy of the use of coal, and did not think that he had overstated the position. Referring to the "King George V.," Mr. Walker said that the results obtained had increased the confidence of the makers of plant in giving guarantees as to the performances of high-pressure and high-temperature installations. The Canadian Pacific Steamship Company's vessels, referred to by Mr. Yarrow, had undoubtedly given very good results. Very onerous guarantees had been given in connection with those ships, but the results were well within the guarantees. Experience in the "King George V." showed that distilled water was necessary when high pressures were used.

Mr. J. Austin said that the high-pressure turbine scheme, owing to its being wedded to water-tube boilers, had its drawbacks. After many years' experience of the running and maintenance of a vessel which had a large number of water-tube boilers of the three-drum small-tube type, his firm had been able, by taking extraordinary care of them, to run them successfully, but they were at all times a source of anxiety. Experience had showed them to be entirely unsuitable for coal-burning conditions, hand-fired. With hand firing it was difficult to keep a head of steam, owing to the impossibility of maintaining an even level of fire, and when manœuvring, the reservoir of steam was so small that a sudden move of the engines caused it to vanish entirely. The working conditions for the firemen were bad, owing to the intense radiation of heat from the casings. Under oil-burning conditions these difficulties vanished and the boilers were satisfactory steam generators. Trouble was experienced, however, from time to time with burst boiler tubes, the bursts being in the form of longitudinal splits, which appeared to be caused by local overheating. A burst tube would put a water-tube boiler out of action, and if the fires were not extinguished promptly, all the tubes would be buckled beyond repair. The tubes burst even under the best running conditions, *i.e.*, with the condensers tight. For successful running, distilled water or fresh water treated in a softening plant for make-up feed was imperative. The distilling of salt water had not proved very satisfactory, owing to the priming of the evaporators. The distilling of fresh water had proved satisfactory, but it was costly, because of the necessity for carrying large quantities of fresh water and the carrying of large quantities of fuel for evaporating it. The most satisfactory method of supplying supplementary feed water was to carry fresh water and soften it by a lime-soda or base-exchange water-softening plant. Sir John had not taken into account the loss of deadweight by carrying water or the weight and cost of the additional fuel used for evaporating purposes. In order to ensure that accidents did not occur, it was imperative to clean the fire row tubes at every opportunity, as the slightest amount of scale on the fire side of the fire row tubes caused overheating, thinning of the tube owing to bulging from the expansion of the heated tube by internal pressure, and finally rupture. The cost of repairs and cleaning of water-tube boilers was therefore very heavy. He would not recommend the adoption of water-tube boilers in a vessel unless she were engaged on a trade which brought her into a home port frequently, so that there would be regular periods for examination and cleaning and opportunities for replenishing the fresh water storage tanks. After a number of years of running, trouble also occurred through the thinning of the tubes by internal corrosion. Pitting would eventually eat its way through the tubes. Diesel engines, which had proved entirely satisfactory for low horse-power, had not yet established themselves as reliable for large horse-powers. With regard to pulverised fuel, he said that the problem of the most suitable type of coal for pulverising required consideration. He suggested that in endeavouring to utilise low-grade coal for pulverising on board ship we were proceeding on the wrong lines. A coal with a high percentage of ash cost more to transport than did a higher-grade fuel, and it occupied more space in the ship; in addition, the crushers and pulverisers had more work to do, and there were great difficulties in getting rid of the ash and slag. He appealed for co-operation between the collieries and those who were developing methods of burning pulverised fuels.

The remainder of the discussion of this paper will be given in our next week's issue.

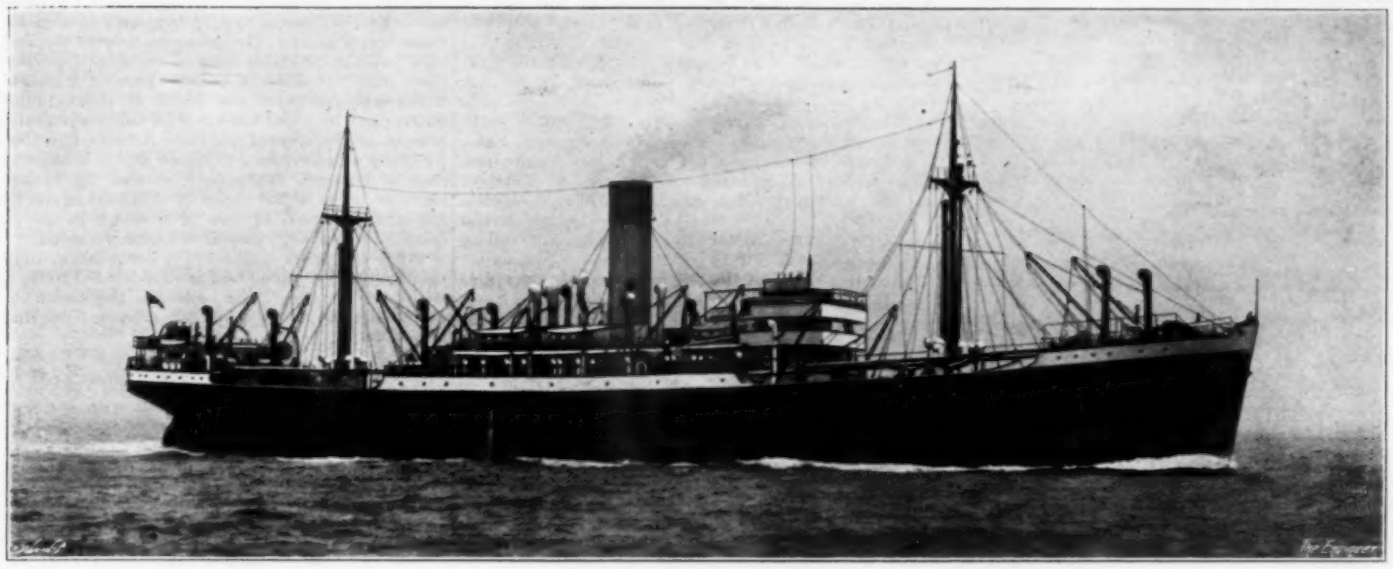
The annual dinner took place on Wednesday evening, March 28th, at the Connaught Rooms. The new President of the Institution, Admiral of the Fleet Lord Wester Wemyss, took the chair. Over six hundred and twenty members and their guests were present, and the evening was a most successful one in every way. After the loyal toasts, given by the Chairman, had been duly honoured, the toast of "The Royal Navy" was proposed by Lord Merrivale, President of the Admiralty Court. Mr. Bridgeman, First Lord of the Admiralty, replied to this toast, and in his speech made reference to the British proposals for the limitation of the size of battleships, the calibre of their guns, and the prolongation of the life of a battleship, which were recently put before the Geneva Meeting of the League of Nations. Mr. Bridgeman expressed the opinion that the measure of limitation proposed would, if adopted, achieve a considerable economy all round, and would not, he said, involve any departures from the balance which was arrived at at Washington. The toast of "The Merchant Navy and Fishing Fleets" was ably proposed by the President, and Commodore Sir Bertram Hayes, Warden of the Company of Master Mariners, replied. The Belgian Ambassador, Baron E. de Cartier de Marchienne, proposed the toast of "The Institution of Naval Architects," and the President, Lord Wester Wemyss, replied. In the course of his speech he proposed that a telegram should be sent to the Duke of Northumberland, the late President of the Institution, thanking him for his seven years of faithful leadership. This telegram was sent in the name of the President and the members of the Institution.

OIL FROM COAL IN SOUTH AFRICA.

THE Government of the Union of South Africa is considering the appointment of a special geologist to investigate and report on the coal and oil resources of the Union. It has also accepted a motion moved in the House of Assembly on February 14th:—"That in the opinion of this House the Government should take into consideration the advisability of instituting a physical and chemical survey of the coal resources of the Union, and of encouraging the production of oil and petrol from oil shale and coal on a commercial scale." The Minister of Mines said that the Government was doing its best. It had been said that it was moving slowly, but the world was moving slowly in regard to the question of producing oil from coal. He admitted, however, that important experiments had been made in Germany as the result of which Germany can utilise very beneficially most of her brown coal, which a short time ago was practically valueless, and it was necessary that we should watch these experiments on which the German firms were spending large sums and see what we could learn from them. There has been no exhaustive geological survey of the coal resources of the Union, but the geological staff of the Mines Department has roughly estimated the quantity at 57,000,000,000 tons, of which a very considerable proportion is of inferior quality. The economic conditions in South Africa are very favourable for the success of an industry for the production of oil from coal. On the one hand there is a considerable and growing market which is absorbing petrol to the value of over three millions sterling annually, and, on the other hand, there is available a practically inexhaustible supply of raw material at a very low price. The highest price for coal at the pits mouth in the Provinces of the Union is 6s. 8·78d., which is the price of Natal coals. In the Orange Free State the average price is 5s. 5·57d. per ton; and in the Transvaal it varies from 5s. 2·94d. in the Middelberg area to 4s. 0·66d. per ton in the Springs-Brakpan area. Private research on the subject has been begun, especially by the Transvaal and Delagoa Bay Investment Co., which has purchased experimental equipment.

THE TWIN-SCREW CARGO MOTOR VESSEL EURYBATES

SCOTT'S SHIPBUILDING AND ENGINEERING COMPANY, LTD., GREENOCK, BUILDERS AND ENGINEERS



The Scott-Still Motor Vessel Eurybates.

FEW British-built motor vessels of recent years have aroused more widespread interest than the first Scott-Still engined 2500 S.H.P. motor vessel the "Dolius." That ship has now completed more than 200,000 miles during her four years at sea. The interest in her is two-fold, for it is centred first on the ingenious way in which use is made of the heat in the exhaust gases and the cylinder jacket cooling water, whereby steam is generated and utilised on the under-sides of the main pistons, and, secondly, on the high overall efficiency of operation thereby attained. It is now generally recognised that the propelling machinery of the "Dolius" is the most efficient afloat, only 8¼ to 9 tons of oil fuel being consumed for all purposes per day of twenty-four hours, at an average speed of 11¼ knots. An illustrated description of the "Dolius" will be found in THE ENGINEER of April 11th, 1924.

The second vessel, the "Eurybates," to be equipped with Scott-Still engines for the same owners is of no less interest. Special metals have been employed in her hull structure and engine castings. A modified and improved design of engine with a total output of double that of the previous vessel, namely, 5000 S.H.P. has been adopted. An account of the main and auxiliary engines and their arrangement in the ship is given in the following article, which is accompanied by a special Supplement drawing. It is of interest to learn that, with a ship of slightly increased length, and with about 700 tons more gross tonnage, an average service speed of 13½ knots will be obtained.

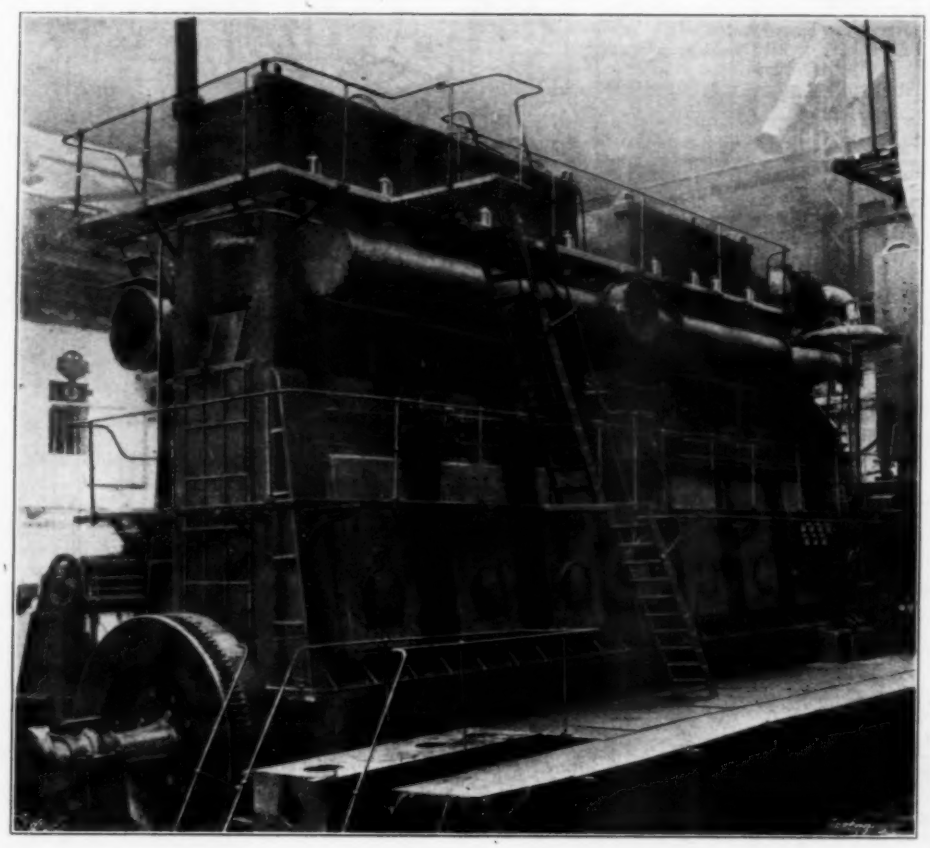


FIG. 1—THE PORT ENGINE ON THE TEST BED

HULL AND MACHINERY PARTICULARS.

The twin-screw motor vessel "Eurybates" has been built and engined by Scott's Shipbuilding and Engineering Company, Ltd., Greenock, to the order of the Ocean Steamship Company, Ltd. (Alfred Holt and Co., managers), of Liverpool. A view of the ship taken on trial is given above. She is specially designed to meet the requirements of the owners' pilgrim-carrying trade, and for this purpose the weather decks are wood sheathed. In general, the navigation and safety equipment accords with the highest standard for British passenger-carrying requirements. The hull is subdivided and is fitted with water-tight doors operated on the Scott-Ross electrical principle. The lifeboats have davit turning-out gears. An emergency lighting set and bilge pump are provided. There are six cargo holds which are served by eighteen electric winches. These winches and the windlass were supplied by John H. Wilson and Co., Ltd., of Birkenhead. The steering gear is of the electric hydraulic type, made by John Hastie and Co., Ltd., of Greenock, and special arrangements are made whereby the stand-by motor-driven variable speed pump for supplying oil to the hydraulic rams can be put into action from the engine-room in the event of any defect occurring in the main set. By this means the steering gear can be operated by either of the two pumps, both of them together, or by the emergency hand-operated gears. The arrangement provides for keeping both pump sets in the hydraulic circuit, and a safety pawl is fitted in order to prevent one pump from motoring the other.

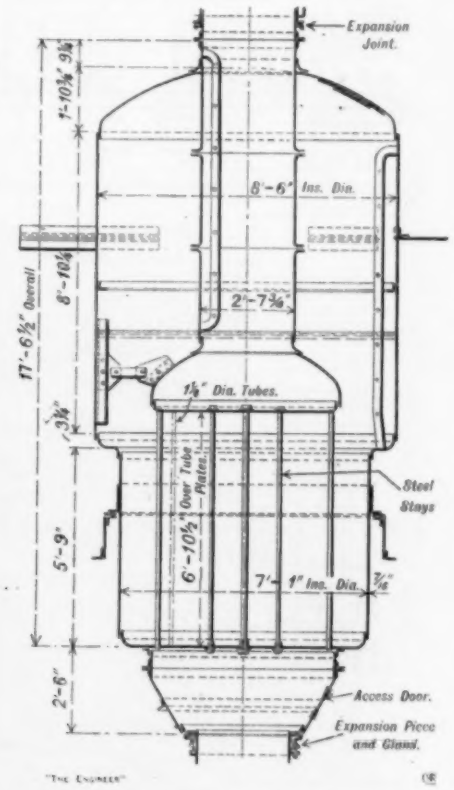


FIG. 2—LOW PRESSURE REGENERATOR

It may be mentioned that the hull structure of the "Eurybates" has been constructed of special high-elastic steel, such as was successfully employed in the owners' earlier vessel, the "Prometheus." By this means some 250 tons increased deadweight carrying capacity has been obtained.

The following are the principal hull and machinery particulars :—

Hull Particulars.

Length between perpendiculars	425ft.
Breadth moulded	54ft. 6in.
Depth moulded to upper deck	32ft. 9in.
Deadweight carrying capacity	7900 tons
Gross tonnage	6400
Designed service speed	13½ knots

Engine Particulars.

Type of propelling machinery	Twin-screw Scott-Still
Total output	5000 S.H.P.
Number of combustion cylinders, each engine	Five
Cylinder bore	27in.
Stroke	45in.
Number of steam cylinders, each engine	Two
Cylinder bore	24in.
Stroke	45in.
Normal running speed	105 r.p.m.
Total output of auxiliary oil electric generating sets	400 kW

Main Engine Design.

From this table it will be seen that each of the main propelling engines has five combustion cylinders and two steam cylinders. Unlike the "Dolius" engines in which, it will be recalled, steam is utilised on the underside of the combustion pistons, in the present engine the combustion cylinders are entirely separate from the two steam cylinders, so that each unit is virtually a five-cylinder single-acting oil engine with two double-acting steam cylinders added.

Fig. 1 shows the port engine erected in the builders' shop, while the drawings reproduced in our Supplement show sections through the oil and steam cylinders, and the five furnace high-pressure regenerator boiler. There is in addition an enlarged section through the top of the combustion cylinder, from which it will be seen that the "Still" type of thin liner construction has been retained. The thin metal walls keep the heat stresses low, and to take the internal working pressure stresses forged steel hoops are shrunk over the liner webs. The vertical forces are taken by through-going bolts, which are made in two portions and pass down from the top of the cylinder almost to the bottom of the bed-plate. All the castings for liners, cylinder mantles and pistons are of Perlit iron. Referring again to the sectional drawing, it will be seen that the liner is surrounded by water, which is in common circuit with the low-pressure regenerator boiler illustrated in Fig. 2. Since the cylinder jacket spaces are maintained at a working pressure of about 15 lb. per square inch, equivalent to a temperature of about 250 deg. Fah., a compression pressure of only 375 lb. per square inch in the main cylinders is sufficient, efficient combustion and easy starting being assured by the heated jackets.

An interesting feature of the new design is the arrangement of rotary supercharging valves controlling the exhaust ports. The five valves, one for each cylinder, are driven at half the engine speed through spiral gearing from the main crank shaft. The valve has a broad lip, the effect of which is to close the exhaust ports on the up stroke of the piston earlier than would otherwise happen; by this means a supercharging effect is introduced. The scavenge air from the turbo-blower, which fills the enclosed space below the piston, gives a cushioning effect on the down stroke. One very important advantage of the rotary valve referred to is that it enables a long piston skirt, such as is usual in two-stroke engines, to be dispensed with. The piston, it will be seen, is very short, and in the new design the builders have found it possible to reduce the total height of the engine by some 30in. With the reduced height it was also possible to adopt a smaller bed-plate width, and considerable saving in weight has thereby been effected.

The combustion pistons are cooled with fresh water through trombone pipe connections, and special means are employed to cool the piston water in a section of the main condenser, which will be referred to later.

The fuel pumps, as shown in the drawing, are mounted at the back of the engine, and the plungers are excentric-driven from a lay shaft geared to the main crank shaft. The plungers deliver the fuel oil at a pressure of about 4000 lb. to 5000 lb. per square inch, and the amount of fuel passing through the automatic valves in the heads of the cylinders is determined by a spill valve. This valve is actuated by a lever at the control station. Attached to the fuel pumps is an emergency governor which is so arranged that it cuts off the supply of fuel by lifting the suction valves in the event of a failure in the forced lubricated system or loss of pressure in the piston oling water supply system, or excessive speed.

With the large diameter of combustion cylinder used in these new engines, it was decided to do away with steam cooling, and to utilise the steam in two double-acting steam cylinders arranged at the for-

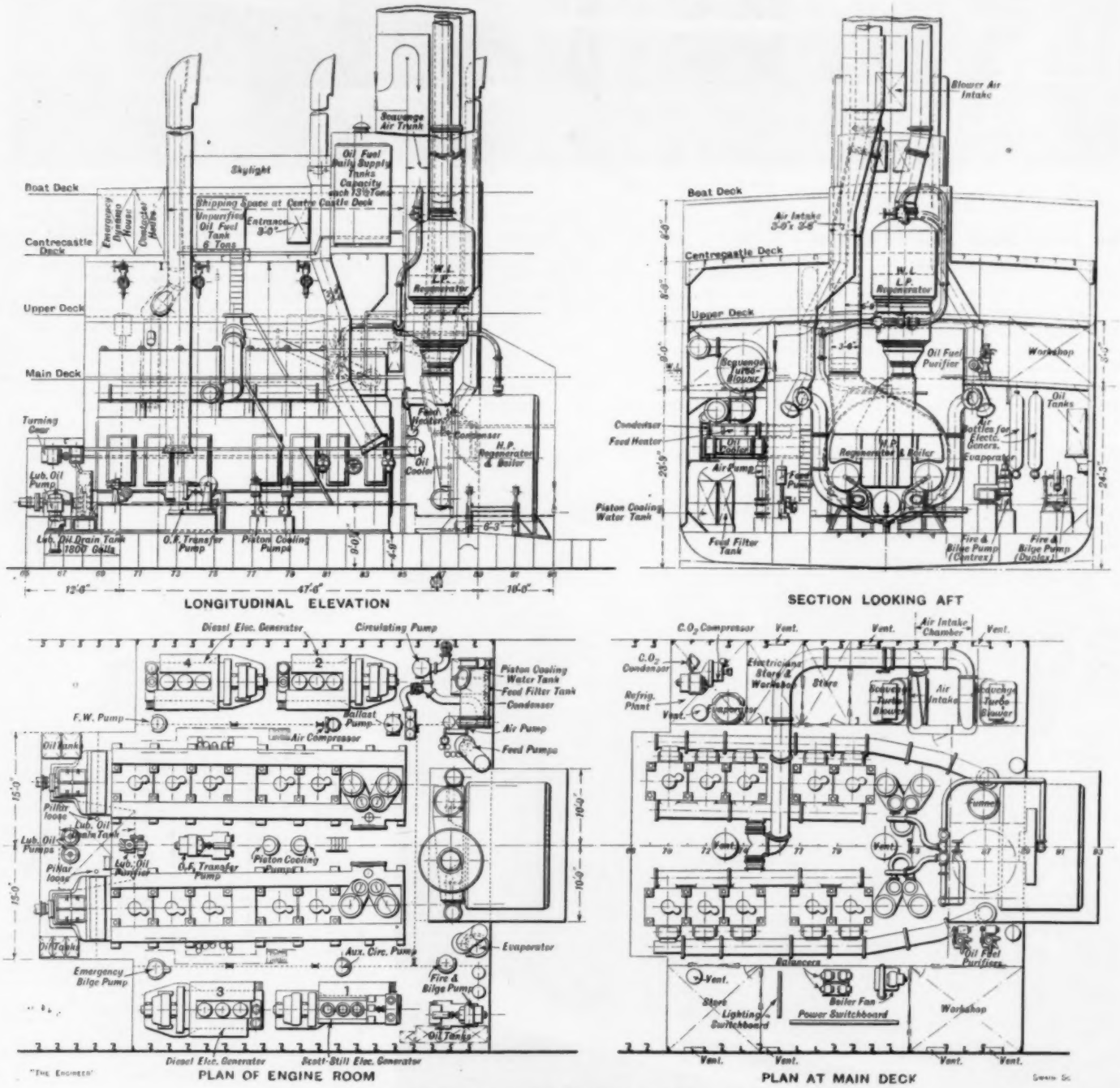


Fig. 3—Arrangement of Propelling Machinery

Reference may be made to the high-pressure and low-pressure regenerator boilers. A drawing of the high-pressure boiler is given in to-day's Supplement. It is of the Scotch return tube type with five furnaces. The centre and two outer furnaces are fitted with Wallsend air atomising oil fuel burners, while the

remaining two furnaces are closed at the front. Through the latter the exhaust gases from the main and auxiliaries engines pass. On leaving the high-pressure boiler they are taken through the tubes in the low-pressure regenerator boiler—shown in Fig. 2—and pass upwards through the funnel to the atmosphere.

HEAT RECOVERY AT SEA.

When the propelling machinery is running under normal conditions at sea, the oil burners on the high-pressure boilers are not in use, and any high-pressure steam which is generated is reduced to 15 lb. pressure by a special valve. It is then admitted to the two double-acting steam cylinders on each of the main engines, where it is joined by the low-pressure steam generated by the evaporation of water in the cylinder jackets. From the steam cylinders the steam from both sources of supply exhausts at about 18in. vacuum to a steam turbine-driven scavenge blower, from which it is rejected to the condenser at 28in. vacuum.

Whilst manœuvring, the burners are lighted in the high-pressure boiler, and the steam cylinders are arranged to take their supply direct from the high-pressure boiler, the scavenge air to the combustion cylinders being reduced as necessary, so that no undue

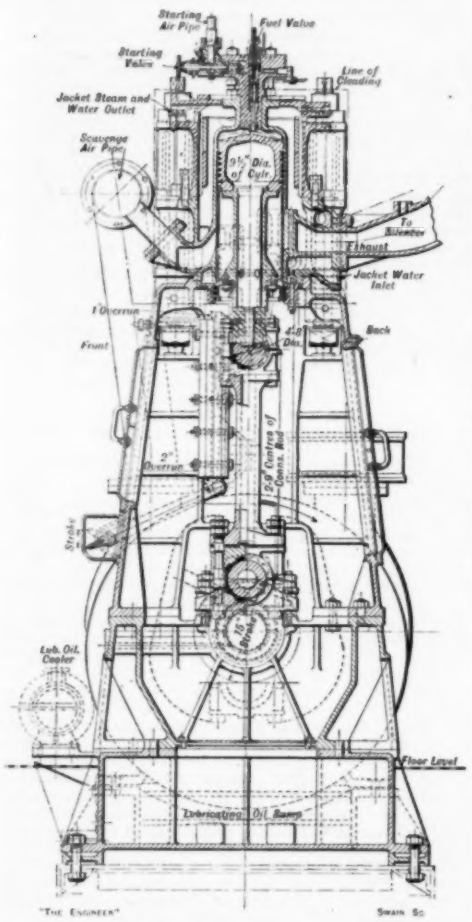


FIG. 4—SCOTT-STILL AUXILIARY ENGINE

cooling of the walls may take place. The steam turbine driving the blower is kept running by passing a small amount of high-pressure steam through it.

From what has been said, it will be seen that the arrangement is one which enables both the main and auxiliary engines to operate under very economical conditions. A further advantage is that in the remote event of the combustion cylinders being put out of action, the steam cylinders would be able to drive the propellers at a reduced speed so long as oil fuel remained to supply the burners.

For starting the engines, fuel is burned under the high-pressure boiler, and the steam generated is used to warm the oil engine cylinder jackets and to give the necessary starting effort. Once the engine is under way, the fuel supply to the boiler is stopped, and the demand for steam is adjusted to equal the amount raised by waste heat.

ENGINE-ROOM AUXILIARY MACHINERY.

The drawings we reproduce in Fig. 3 show the general arrangement of the main and auxiliary engines and other engine-room machinery. The length of the engine-room itself is only 47ft. 6in., while even if the length of the thrust recess and the forward recess, in which the high-pressure boiler is placed, be added, the total length is only 70ft. The wing spaces at bottom platform level are mainly taken up by the four 100-kW oil engine driven generator sets which supply current for power, lighting and heating, and the operation of the ship's galleys. One of the auxiliary sets, which we shall deal with first, is driven by a Scott-Still two-stroke engine of new design, whilst the other three are fitted with Mirrlees marine type four-stroke engines.

In Fig. 4 we show a section through the Scott-Still engine, and in Fig. 5 a general view of the set is given. The engine drives a Reavell rotary scavenge blower through a flexible coupling. A fly-wheel is interposed between the engine and a 100-kW 220-volt Laurence Scott direct-current generator.

The three cylinders have a bore of 9½in., with a stroke of 15in., and develop the full output of about 160 B.H.P. at a normal speed of 300 r.p.m. Like the main engines, this engine has exhaust and scavenge ports, but it may be noted that a long-skirted piston is used, and that there is no supercharging valve outside the exhaust port. The main bed-plate is mounted upon a deep supporting base, and to it is bolted the crank case, to which, in turn, the cylinder jacket and cover are secured by through-going bolts. It will be seen that a special cylinder jacket with a lagged and cleaded cylinder head is provided. The castings for the cylinder, mantle and pistons are all made of "Perlit" iron. These jackets are connected through piping to the low-pressure regenerator illustrated in Fig. 2. Steam is not used below the pistons, but when at sea the exhaust gases of the auxiliary engines pass through both the high-pressure and low-pressure regenerators, alternative exhaust pipe connections being provided to allow the gases to pass directly to the atmosphere when the ship is in port and the main engines are not in operation.

The engine is arranged to work on the airless injection principle, with automatic fuel valves, the period of injection being determined by a spill valve controlled by the governor through an oil relay valve and piston. Hand-operated fuel control gear is also provided. The engine is started on compressed air, and the timed air-starting valve is fitted on No. 3

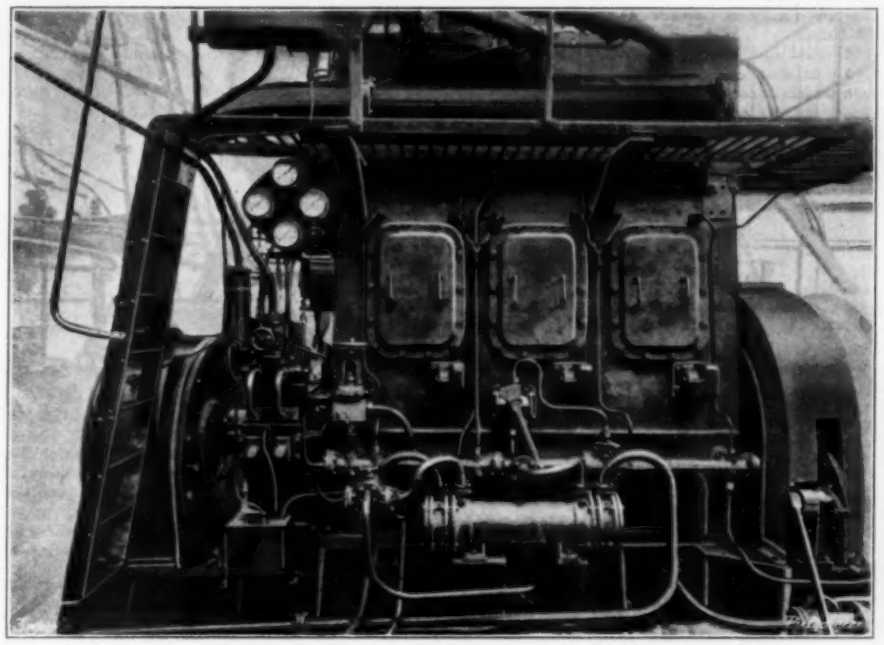


FIG. 5—100 kW. SCOTT-STILL AUXILIARY GENERATOR SET

cylinder. The fuel pumps are grouped on opposite sides of the crank shaft at the governor end of the engine where the starting and running controls are also conveniently placed. Forced lubrication is fitted to all bearings, the oil being delivered under pressure from a "Roloid" type gear wheel pump worked from the lower end of the governor vertical shaft. This oil also supplies the governor relay cylinder. An oil cooler of the "Serck" pattern is fitted for use when in tropical climates. The engine we have described is generally robust in construction, and would seem to be well suited for auxiliary work on board ship.

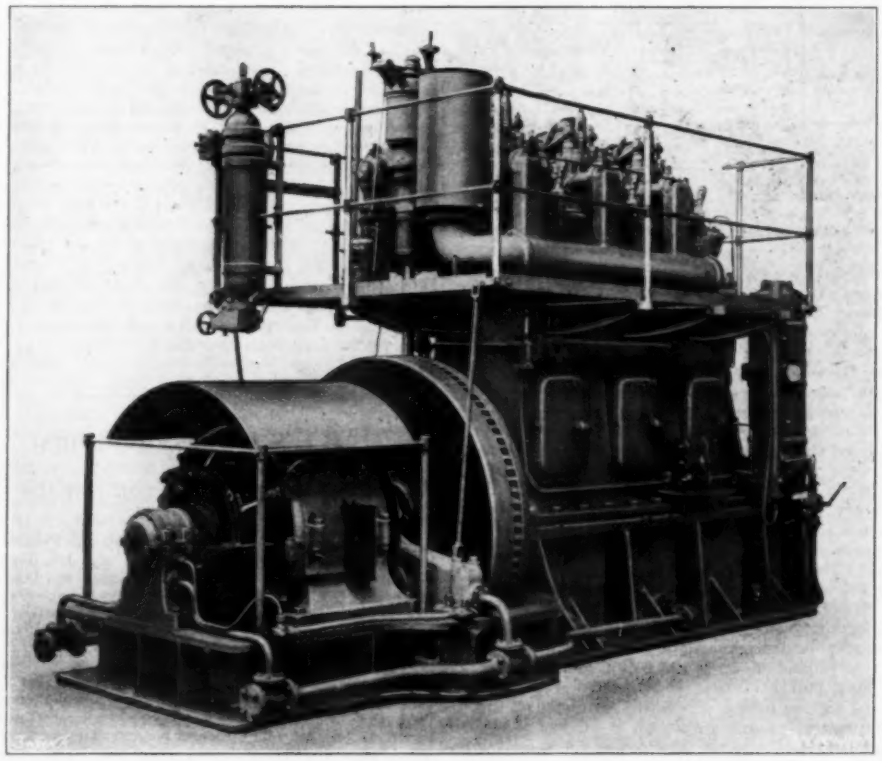


FIG. 6—100 kW. MIRRLEES AUXILIARY GENERATOR SET

In Fig. 6 a view is given of one of the three 160 B.H.P., 100-kW generator sets, supplied by Mirrlees, Bickerton and Day, Ltd., of Hazel Grove, near Stockport, to which Laurence Scott generators are also fitted. Each engine has three cylinders with a bore

of 12in. and a stroke of 18½in. A section through one of these cylinders is reproduced in Fig. 7. A deep girder type bed-plate is used, and to it is bolted the mono-block casting forming the crank chamber and the cylinder jacket. The liners are fitted into this casting. The cylinder covers are of robust construction. As the drawing shows they are provided with inspection doors giving access to the water spaces. The pistons are of the trunk type with the firm's new type of floating piston pin. Access to the running parts is given by inspection doors on the crank case. The exhaust valve levers are split and hinged so that the valve may be taken out and replaced in the shortest time.

As indicated in Fig. 6 the air injection bottle is raised to platform level, so that all starting controls can be operated from the platform. A three-stage compressor with a larger intercooler is fitted. Forced lubrication is applied to all bearings, but the pistons are served by mechanically-operated lubricators. The exhaust pipes lead into a special silencer at the governor end of the engine.

Other important auxiliaries include two steam turbine driven scavenge blowers, which are arranged on a main deck flat at the forward end of the port wing space. They were supplied by the British Thomson-Houston Company, Ltd., of Rugby. The turbines are of the three-stage mixed-pressure type. Each of the two units is designed to be capable of supplying the full amount of scavenge air at the appropriate pressure when the main engines are operating under full power conditions. The condenser, which

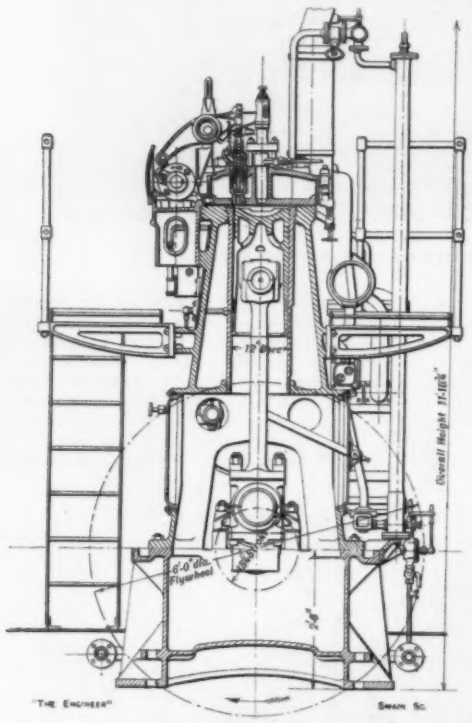


FIG. 7—MIRRLEES AUXILIARY ENGINE

is designed for a working vacuum of 28in., is arranged immediately below the turbines. The condenser has a tube surface of 1200 square feet for the condensation of steam, whilst 240ft. of tube surface is provided in a special section of the condenser for the final cooling of the piston cooling water for the main engines. By means of a special control valve, which works in conjunction with a speed-regulating governor, a certain amount of steam is by-passed through a silent blow-off connection to the condenser in the event of the blower speed becoming excessive and the air pressure becoming greater than necessary. In addition to this valve an emergency governor shuts off the supply of steam from both the high-pressure and low-pressure generating systems, should circumstances require it.

The drawing in Fig. 3 shows the very complete installation of pumps for the fuel oil forced lubrication, cooling water and the usual bilge, ballast and other ship and engine-room services. The arrangement is typical of up-to-date motor vessel practice. We may call attention to the two 13½-ton daily oil fuel service tanks, which are arranged at the top of the engine-room. Provision is made for treating both the fuel oil and the lubricating oil in centrifugal separators. For this purpose a 6-ton tank for unpurified oil is fitted high up in the engine-room. The lubricating oil drain tank occupies a part of the double bottom of the ship and holds about 1800 gallons of oil.

The two switchboards for lighting and power are arranged in a special flat at main deck level on the starboard side of the ship. A three-wire, 110-volt, direct-current system is employed for the lighting service, and two sets of rotary balancers are provided to compensate for any out-of-balance current. They are connected across the 220-volt outer mains and maintain 110 volts between the neutral and the outers. Each set is designed to deal with a steady out-of-balance current of 30 ampères, and one machine is arranged to act as a stand-by unit when the other is in use.

Trial Results.

On the completion of the two main engines towards the end of last year, bench trials were made with only such of the heat-recovery plant attached as was required for the actual running of the engines. This being so, the performance of the engine referred to in the summary given below will probably be improved upon under actual service conditions, when the complete waste heat recovery plant we have described is in operation. As they are, however, the results obtained are remarkably good.

Bench Trials.

	Starboard engine.	Port engine.
Total B.H.P.	2480	2485
Revolutions per minute	106·3	106·5
Fuel oil consumption, lb. per B.H.P. hour	0·38	0·375
Scavenge air pressure, inches of water	57·0	58·9
Forced lubrication pressure, lb. per square inch	22·5	20·4
Exhaust gas outlet temperature, deg. Fah.	537	495
Piston cooling water outlet temperature, deg. Fah.	143	159
Piston cooling water pressure, lb. per square inch	24·0	18·4

The work of installing the machinery was begun early in the year, and was so far advanced that it was possible to deliver the vessel about a fortnight earlier than had been expected in order to meet the owners' wishes. Following a basin trial, preliminary and measured mile trials were run at Skelmorlie on Thursday and Friday, March 15th and 16th. By the courtesy of the owners and builders, we are able to give the means obtained during four runs made over the measured mile on the second of those days.

Measured Mile Trial Results.

Mean draught	15ft. 11in.
Speed in knots	15·06
Revolutions per minute	110·9
Total I.H.P.	5371
Steam pressure, high-pressure boiler, lb. per square inch	177
Steam pressure, low-pressure boiler, lb. per square inch	13·25
Vacuum, inches mercury	28·25
Scavenge air pressure, inches of water	60
Forced lubrication pressure, lb. per square inch	19
Piston cooling water pressure, lb. per square inch	23
Exhaust gas outlet from cylinders, deg. Fah.	571
Exhaust gas outlet from low-pressure boiler, deg. Fah.	310
Piston cooling water inlet temperature, deg. Fah.	108
Piston cooling water outlet temperature, deg. Fah.	153·5
Forced lubrication temperature, deg. Fah.	92

In the main, the trials made took the form of manœuvring, steering, circling and astern operations. As there were no long runs at steady speeds and no special arrangements were made to measure the fuel used by the engines, the consumption figures were not obtained. Manœuvring trials were successfully carried out. The ship was in light condition, and therefore no attempt was made to run the engines at the speed necessary for developing their maximum output. A run made at a steady low engine speed of about 39 r.p.m. was carried out with the high-pressure boiler burners lighted, and was continued for sufficient time to demonstrate the ability of the engines to work very satisfactorily under such conditions. On other occasions during the trials the engines were run as required for some time at speeds as low as 20 r.p.m. The results of the vessel's maiden voyage will be awaited with considerable interest.

B.E.S.A. Specifications.

CUP AND COUNTERSUNK BOLT HEADS, NUTS AND WASHERS.

A specification recently issued by the British Engineering Standards Association deals with the dimensions of black, iron and steel, cup and countersunk bolt heads, nuts and washers. Six types of bolt heads are dealt with in the specification, for use in connection with iron or steel work and woodwork, and nine sizes are listed from ¼in. to 1in. in diameter. Hexagonal and square nuts are specified, the dimensions being those formerly issued by the Association in 1908 in report No. 28. The washers for use with the bolts are of five types, having round and square holes, and two patterns are of taper section for use with steel angles, channels and beams. The specification is numbered No. 325, 1928, and copies may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

COLLIERY MATERIALS.

In continuance of its programme of work in the Colliery Section, the British Engineering Standards Association has just issued British Standard Specifications for the Quality of the Material for Colliery Cage Main Shackles and Bridle Chains and for Colliery Rope Capels or Sockets for use in hauling or winding men. These specifications have been prepared at the request of the Mining Association of Great Britain by Committees representative of both the buying and the manufacturing interests, which have been assisted in their work by Regional Committees which have been formed in the larger coalfields to ensure that local conditions and practice receive proper consideration.

As in the case of all British standard specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary, and revised issues will be published from time to time. The importance of the use of the best quality material for such appliances as cage shackles and chains and for the rope sockets used in hauling or winding men, cannot be over-estimated, and the materials which are included in these specifications may be said to be the best quality obtainable for the purpose. The use of the specifications by collieries will serve the double purpose of both facilitating safe purchase on a competitive price basis and of affording some measure of protection to the colliery manager and limiting his difficulties in the event of serious accident. Anything which will tend to lighten the heavy responsibilities of the colliery manager is to be welcomed.

Copies of these two new specifications (Nos. 322 and 323) can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

GREY IRON CASTINGS.

A specification which covers two grades of Grey Iron Castings for General Engineering Work, has just been published by the British Engineering Standards Association. In it provision is made for both transverse and tensile tests, and the engineer or purchaser must state at the time of the inquiry which he requires, or both. Three sizes of test bars, small, medium and large, have been standardised, and are related to the main cross-sectional area of the castings or castings represented. Where the design of the castings permits the engineer or purchaser may specify cast-on test bars. The number of transverse and tensile tests is based on the weight of the castings. The specification includes appendices giving a concise summary of the testing requirements, a note on the method of calculating the modulus of rupture, and curves showing the minimum breaking loads to be obtained in cases where the transverse test bars as cast are slightly over or under the standard diameter.

This Specification (No. 321, 1928) may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

BROKEN STONE CHIPPINGS (NO. 63—1928).

A revised edition of the British Standard Specification for the Gauges of Broken Stone and Chippings has recently been issued to supersede that published in 1913. In the course of the revision investigations of current supplies were carried out by a number of highway engineers, as a result of which the Association satisfied itself that the gauges specified in 1913 were such as substantially to meet present-day requirements. It was found in 1913 that the specification could be met by the majority of the quarries, as material of the proportions standardised was in fact being supplied, though the quarries frequently differed in the nomenclature used to describe the gauges.

The investigations recently made prove that the observations of 1913 hold to-day, but the number of quarries able to comply with the standard has increased. The British Engineering Standards Association therefore hopes that highway engineers will adopt the specification in their practice and order broken stone and chippings in terms of the British standard. The specification is accordingly re-issued with the technical requirements unmodified. Certain editorial modifications have, however, been made, and metric equivalents of the dimensions have been added.

Copies of the new edition of the specification, No. 63—1928, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

ULTRA-SONOROUS WAVES IN NAVIGATION.

At a recent meeting of the Society of Civil Engineers of France, Monsieur P. Langevin, Professor at the College de France and Director of the School of Industrial Physics and Chemistry, read a paper on the production and utilisation of ultra-sonorous waves.

Ultra-sonorous waves are merely sound waves of a very high frequency. This frequency may extend from 20,000 to several million vibrations a second. These sounds can be projected beneath water, in the same way as a luminous vibrations, by electrical apparatus with a power of several kilowatts and can thus be used for submar ne soundings and signalling. They strike the bottom of the sea and are reflected and analysed on their return. The emitting apparatus also plays the part of a receiver.

In order to obtain this result Monsieur Langevin, utilising the piezo-electric properties of quartz discovered in 1880 by Pierre and Jacques Curie, made an extremely simple and strong ultra-sonorous projector, which, fed by a high-frequency alternating current, renders possible the emission in the water of a bundle of ultra-sonorous waves of the same frequency, similar to the luminous beam of a lighthouse, but moving only with the speed of sound, or about 1500 m. a second. The same apparatus, combined with electrical amplification and detection devices, acts as a receiver of the waves, and consequently plays the same part for them as the simultaneously emitting and receiving antenna plays for the Hertzian waves.

The apparatus has already been used for submarine signalling and detection, as well as for continual soundings on ships moving at any speed. Conclusive experiments made at Calais have shown the possibility of signalling with precision the entrance to a port in foggy weather.

Railway Matters.

ON March 2nd, in connection with the appointment of his successor, we announced that Mr. V. A. Robertson had resigned his position of Stratford divisional engineer, London and North-Eastern Railway, to take up another railway appointment. We are now able to state that Mr. Robertson's new position is that of civil engineer, under the chief engineer of the Underground system, in succession to Mr. C. E. Stanier, who has had to retire owing to ill-health.

ON Monday last Mr. R. J. Insell died after a long illness. He held the unusual position of engineer of both signals and telegraphs on the Great Western Railway, and was responsible directly to the general manager. He was connected with the Great Western, always in the signal department, since his youth, was made assistant signal engineer in 1900, and succeeded Mr. A. T. Blackall as signal and telegraph engineer in 1923. He was very popular amongst railway men.

THE London, Midland and Scottish Railway Company spent last year £1,561,592 out of capital. Of that sum, £140,990 went on electric train vehicles, £9988 on improvements of locomotive stock, £514,346 on improvements of carriage stock, £184,096 on improvement of wagon stock, and £129,173 on manufacturing and repairing plant and works. During the current year it is proposed to spend £2,789,000 out of capital, of which £1,383,000 is for railway works, £666,000 for rolling stock, £62,000 for goods and parcels road motor vehicles, and £129,000 for extensions at various docks.

THE Ministry of Transport railway statistics for the month of December last have been issued as a Stationery Office publication, price 3s. 6d. They show a decrease, when compared with December, 1925, of 1·8 per cent. in the number of passenger journeys and of 2·9 per cent. in the receipts from passengers. The number of passengers carried at reduced fares was 3,910,207 more, but the full-fare passengers were 5,770,800 less. The passenger train mileage increased by 4·4 per cent. The tonnage of freight fell by 4·2 per cent. and the net ton-miles by 5·6 per cent., but the freight train mileage was only 1·0 per cent. less. Thanks to the increase in some rates, made in February, 1927, the freight train receipts fell by only 0·5 per cent.

WHEN the general powers Bill of the London, Midland and Scottish Railway came up for second reading on March 13th, a South Wales Labour Member said that the companies should show a more generous spirit in the matter of victimisation of their men who had taken part in the stoppage of 1926. The remark called forth the assurance of Mr. Bromley, a fellow Labour Member and the secretary of the Associated Society of Locomotive Engineers and Firemen, that the railway companies in that respect had set an example which might well be followed by other employers of labour. Of the hundreds of railwaymen who had been unwise enough to place themselves within the reach of the law, there were now less than half-a-dozen who had not been reinstated, and even their cases were now receiving consideration by an official of the companies.

IN August, 1926, it was announced that the Southern Railway directors had ordered the carrying out of a further scheme of electrification. Most of the work was to be on the central, or former Brighton, section; one short length was on the western or South-Western, section, and the only portion on the eastern, or South-Eastern and Chatham, was the branch from Purley to Caterham, and that from Purley to Tattenham Corner. The work was to be carried out in three instalments. The main feature of the first programme was the old Brighton line between London Bridge and South Croydon, thence over the Redhill joint line to Purley, and forward, over the eastern section, to Caterham and Tattenham Corner; also from Penge to the low-level station at the Crystal Palace. The next stage was to be between London Bridge and Victoria, on the one hand, and Sutton, *viâ* Mitcham Junction on the other; from Sutton to Epsom Downs; from Sutton to Epsom; and from Streatham Junction to Wimbledon. The last stage was to be the substitution of operation by third rail in place of by overhead construction on those lengths of the Brighton section to be worked, *i.e.*, the South London, Victoria to Coulsdon, Selhurst to Sutton *viâ* West Croydon. The first part of the programme was opened on Sunday last, March 25th, and it was of interest in that it was the first portion of the former Brighton section to have the third rail. It is hoped to complete the second stage in June and to finish the programme early next year.

IN this column of our issue of November 11th last mention was made of a head-on collision on October 31st at Ware, on the London and North-Eastern Railway. The report thereon by Lieut.-Colonel Mount has recently been issued. From that document we learn that whilst there were no serious injuries to the forty-five passengers in the two trains, two of the enginemen were seriously hurt, and four coaches on the up train were telescoped and smashed beyond repair. Ware Station is laid out in an unusual manner. The line from St. Margaret's in the London direction and that from Hertford in the other direction are double tracked, but for 186 yards through the station the line is single, and only one train can be in the station at the same time. On the evening in question there was a drifting fog of varying density, but no fogmen were out. The up train arrived at 8.48, and in view of the platform being occupied, a down train was only accepted under the "warning arrangement," and the signals were kept "on" against it. The signalman at St. Margaret's omitted, however, to warn the driver of the down train, and as the latter man failed, owing to the fog, to see that the distant and home signals were at "danger," his train fouled the single line section in the station and came into collision with the departing up train. Colonel Mount puts the main blame for the accident upon the signalman at St. Margaret's, but also censures the driver for not handling his train with greater care. Some severe criticisms are also passed on the methods of block working that have been allowed to develop. It is remarked that the case is also illustrative of collisions preventable by a system of automatic train control.

Notes and Memoranda.

WHEN the bids for the foundations of the Manhattan Tower and anchorage of the new Hudson River Bridge were recently opened it was disclosed that prices ranged between such wide limits as 986,600 dollars and 1,773,425 dollars.

EXPERIMENTS are being made with concrete roads in the United Provinces of India. More than 16,500 square yards of concrete road have been laid in Benares, and a 14-mile stretch is to be laid from Benares to Moghal Serai. The Allahabad Improvement Trust is reported to be contemplating laying a long stretch of concrete road through that city. The experiments are held to be a manifestation of the Government "good roads" movement. Concrete construction in India, it is said, would prove a great boon to the depressed Indian cement industry.

THE developed water power in the United States on January 1st, 1928, was 12,296,000 horse-power, showing an increase of 575,000 horse-power, or approximately 5 per cent. during 1927. The total amount of potential water power available 90 per cent. of the time is 38,110,000 horse-power, and that available 50 per cent. of the time is 59,166,000 horse-power. If it were feasible to develop all the water power resources of the United States, the total capacity of water-wheels installed at all water power plants would amount to about 85,000,000 horse-power.

IN the course of some remarks made at a dinner of the London Association of Foremen Engineers, Sir Philip Dawson said that the great difficulties which confronted the engineering industry in this country to-day were especially pressing in the case of the electrical branch. British electrical manufacturers to make a very slight margin of profit had to quote prices which were 27 per cent. higher than those of their Swiss, Belgian and Italian competitors. It was very regrettable that the corporations of many of our great cities were placing orders for electrical machinery in foreign countries.

IN the course of a recent address, Dr. Saklatwalla, vice-president of the Vanadium Corporation of America, said that phenomenal as the growth of general steel tonnage might seem, the growth of alloy steels during the last few years had been still more surprising. According to a calculation based on statistics, the alloy steel industry had progressed eighteen times as rapidly as the general steel industry over a period of fifteen years. Alloy steels had entered fields where their application could hardly have been prophesied, and this development was responsible for present-day engineering advancement.

A BULLETIN detailing the results of experiments on the carbonisation of brown coal and brown coal briquettes by the Research Department of the State Electricity Commission of Victoria has been issued by the Commission. The object of the Commission was to explore the possibility of:—(1) Providing from the State's own brown coal resources a solid fuel suitable for locomotive purposes, as well as for other purposes for which high-grade solid fuel is required; and (2) obtaining from brown coal a gas suitable for town's gas supply. The results of the Commission's investigations give promise of an ultimate satisfactory answer to these two questions.

A COMMITTEE has just been formed to carry out preliminary arrangements for holding an international exhibition in Paris devoted to all aspects of light and lighting. It will bring before the public everything relating to the scientific aspects of light and will also show improved methods of lighting for all purposes, such as the illumination of shop windows and theatre stages. It is felt that, notwithstanding the progress made in the methods of illumination, there is still much to be done in the way of artistic and economic development, and the provision of suitable sources of light to produce new and improved effects is regarded as a science that depends in a large measure upon electrical engineering.

A NEW industry, of vast importance to Bengal, is in sight, states the Indian correspondent of the *Chamber of Commerce Journal*. Gangwa sawdust is obtained from a tree which grows abundantly in the Sunderbans and is the cheapest wood in the market. There are at least 100 tons of sawdust available from a few sawmills of Calcutta, and by introducing proper forestry regulations the growth of the tree in forests could be maintained perennially. Professor Sen, in the course of an address at the Science Congress held in Calcutta early in February, stated that he obtained from semi-large-scale experiments 39–40 gallons of absolute alcohol from a ton of Gangwa sawdust, whilst the usual figure obtained with other varieties in other countries was in the region of 20–22 gallons. The cost of production per gallon of spirit was slightly higher than 6 as., which pointed therefore to a great prospect for the industry in the province. It is stated that the Union Distillery of Calcutta is arranging to erect an experimental plant to give this process a large-scale trial.

SHEETS of metal so thin that ordinary type can be read through them are now available as the result of research by Dr. Carl Mueller, of the Charlottenburg Laboratory, Berlin. According to *Nature*, his method of preparing them is to electro-plate the metal on the surface of some soluble substance, such as rock salt, and then dissolve away the support. A ring of thicker metal can be used to support the films, of which two and a-half million would have to be piled to make a stack an inch high. Such films have been made of iron, nickel, gold, silver, and platinum, and it is found that although the nickel is much less transparent to visible light than gold, it readily transmits the shorter ultra-violet rays. The films are very elastic, and will bulge out for as much as a tenth of their diameter without breaking. Another curious thing about them is their high electrical conductivity. As these films are practically all surface, a strip of film containing no more metal than in a round wire one-hundredth of a millimetre in diameter will carry enough current to light several lamps; if the same current were passed through the wire the latter would be instantly melted. This film may find use in radio and phonograph reproducers, since ordinary diaphragms are so heavy that they dampen some of the overtones and so coarsen the sounds.

Miscellanea.

IT is proposed to erect a beet sugar factory at Warrnambool, Victoria.

IT is reported that H.M. destroyer base at Port-Edgar is not to be closed down after all.

A WIRE-DRAWING factory is to be put up at Ojibway, Ontario, by the United States Steel Corporation.

IT is estimated that the full development of the water power of the Tennessee River will cost one thousand million dollars.

IT is announced that Yarrow and Co., Ltd., of Scotstoun, propose to establish a shipbuilding yard at St. John, New Brunswick, for the construction of shallow-draught craft.

A GOOD record was recently set up in the United States when 63 miles of double track railway were completed in ten months. The work involved the excavation of a million cubic yards of rock and four million cubic yards of earth, besides the handling of 10,000 tons of structural steel and the mixing of 100,000 cubic yards of concrete.

IT is reported from Sydney, New South Wales, that Dorman, Long and Co., Ltd., and Baldwins, Ltd., and Howard Smith, Ltd., steamship owners, contemplate joining the Hoskin Company for the purpose of developing the iron and steel trade at Port Kembla. The new company will have £5,000,000 capital, and contemplates the erection of one of the most up-to-date plants in the British Empire.

THE Koninklijke Paketvaart Maatschappij, Amsterdam, has placed an order for the construction of seven motor-ships of 165ft. 6in. in length, 28ft. 8in. in breadth, 10ft. depth, and of 783 tons displacement on 8ft. mean draught, with the Intermaas Shipbuilding Company, Slikkerveer. The machinery for these vessels, which are to be used in the East Indian coasting services, will be constructed by Messrs. Sulzer Brothers, Winterthur.

IT is reported from Moscow that the Kalinin works of the Machinery Trust has turned out the first cloth weaving loom of the Schwabe type to be manufactured in the Soviet Union. Up to the present looms of that type have all been imported. It is said that the loom is equal in quality to those of foreign manufacture; that it makes up to 85 revolutions per minute; and that it weaves very strong cloth. At present it costs the works about 2500 roubles (£250) to produce, but it is anticipated that, when manufactured in quantities, the cost will fall to 2000 roubles (£200). The works has already received orders for 330 of these looms. As from June twenty looms a month will be turned out, the full capacity of the works, it is stated, being thirty a month.

THE most important iron and steel works in Mexico is situated at Monterrey, the fourth largest city in Mexico, and an important railway junction, not more than 100 miles from Laredo on the United States border. The iron ore is from the famous Iron Mountain, known as the Cerro del Mercado, near Durango. Although the Monterrey Company is an active concern, it is some years since the volume of business came up to expectations. During 1926 the blast-furnaces produced some 60,000 tons of pig iron. The steel output was of 78,000 tons and the rolling mills turned out about 32,500 tons of heavy steel rails, joists, channels, angles and bars. The company has started to produce ferro-manganese, and it is understood that the results have been satisfactory.

IT is reported that a number of experimental electrical farms are to be established in Manitoba. The scheme is to be formulated and controlled by a general committee comprising representatives of electrical, manufacturing and agricultural interests, who will select a number of farms which are to be electrified. Data will be obtained with a view to providing information of value in connection with the preparation of schemes for the general electrification of wide farming areas. Farmers in the district are said to be realising that with electric power available operating costs can be reduced, and that the expenses entailed in providing extra tractors or horses at the rush periods can be eliminated. The movement in favour of the electrification of farms is apparently not only growing in the West, but is gradually spreading eastward.

THE University of Toronto has established a new course in aeronautical engineering in the Department of Mechanical Engineering. It will be an optional course embraced in the third and fourth year of the Department. The new fourth year option will be directed especially towards aerodynamics. The new course provides only for those students who may be proceeding to the degree of applied science, and owing to the limited space in the aerodynamic laboratories the number of students permitted to take it will necessarily be limited. The laboratory contains the only wind tunnel in Canada. It was established there during the latter part of the war and has been the means of carrying out important research work. The new course will be under the general supervision of Professor R. W. Angus, head of the Department of Mechanical Engineering, and the lectures and the laboratory work will be more particularly carried out by Professor J. H. Parkin, of the Department.

THERE is a movement on foot in the United States to secure the assistance of the Government and railways for the development of the coal export trade of the country. For some time past the colliery owners in the West Virginia area have been agitating for a differential rate of coal intended for export to foreign destinations. The differential rate system is an integral part of the distributing organisation of the American coal trade, but hitherto it has not been applied to any appreciable extent to the coal export trade. It is now, however, the intention of the colliery owners in the most important of the steam-coal districts of the States to inaugurate a regular service to the Mediterranean ports, if the necessary support is forthcoming. It is reported that the United States Shipping Board is favourably inclined towards the scheme. The House of Representatives a few weeks ago passed a Bill giving the Shipping Board power to apply out of its fund a sum of 1,000,000 dollars to the reconditioning of ten vessels for the oversea coal-carrying trade.

STATIC BALANCING MACHINES FOR ROTORS

(*For description see page* 338)

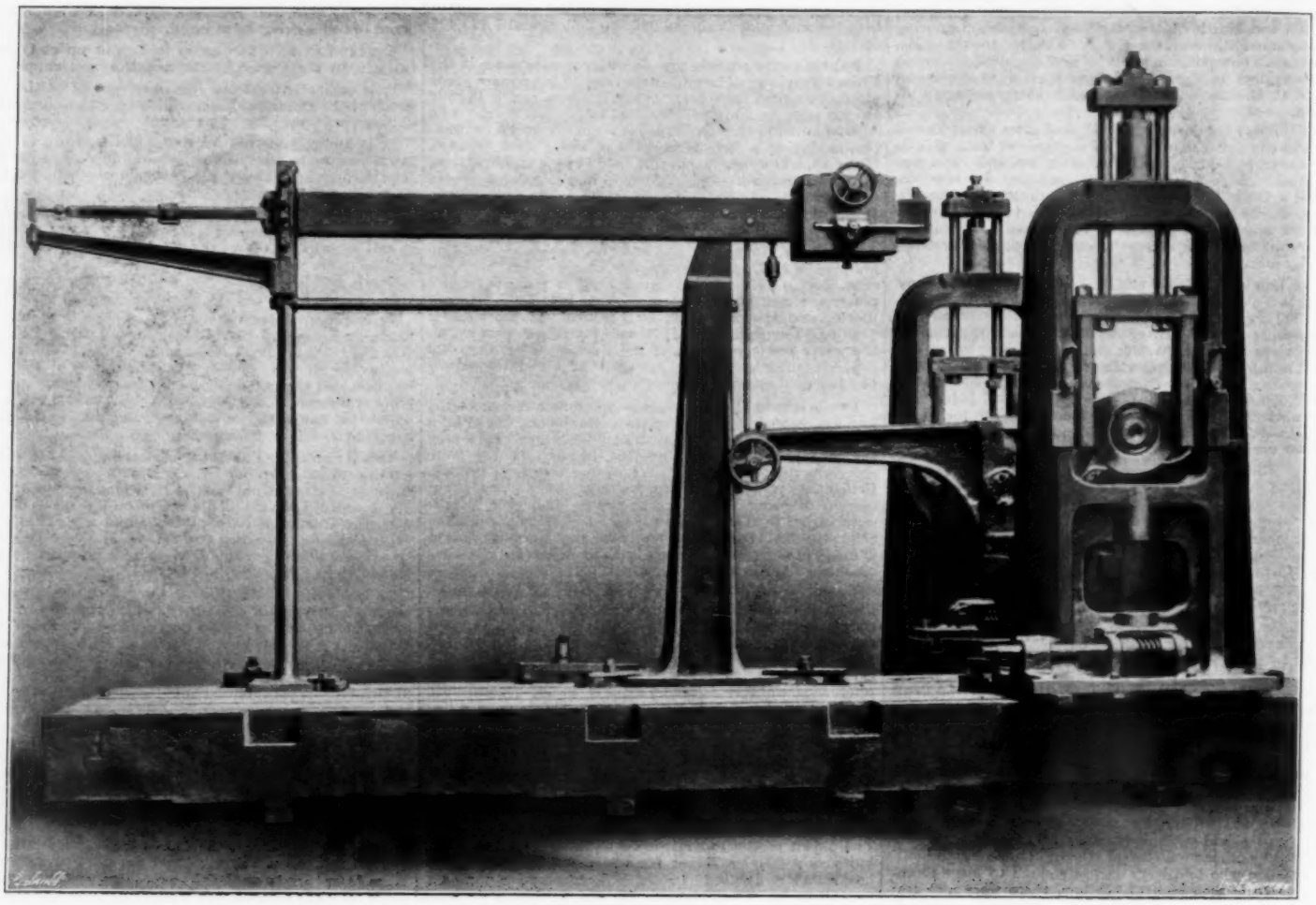


FIG. 15—15-TON DOUBLE-ENDED MARTIN BALANCING MACHINE FOR NAVAL ROTORS, GEARS AND PROPELLERS

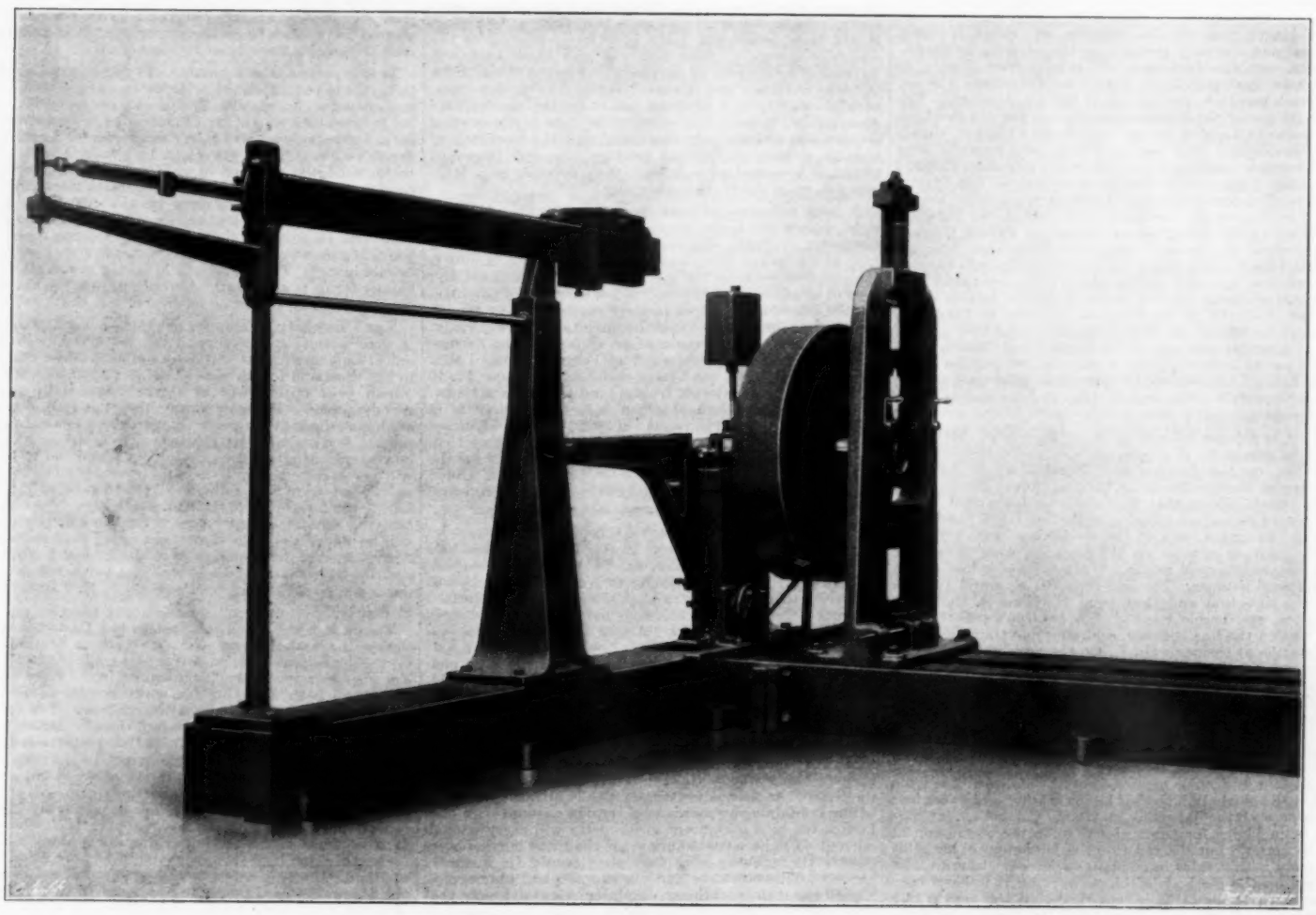


FIG. 16—15-TON SINGLE-ENDED MARTIN BALANCING MACHINE AT H.M. DOCKYARD, PORTSMOUTH

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The Metallurgist

THE MARCH NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

ON March 20th, 1928, at his residence, The Grange, Sandbach, SAMUEL POOLE TWEMLOW, managing director of Fodens, Ltd., aged sixty-one years.

THE ENGINEER.

MARCH 30, 1928.

The Strength of Steam Boilers.

AMONGST engineers who have added to our knowledge of boilers there are few who have done as much to clear away obscurities and to put boiler design and operation on a sound basis as Mr. C. E. Stromeyer. For more than thirty years he has been the chief engineer of the Manchester Steam Users' Association, and year after year he has issued a "Memorandum" which has been remarkable alike for an intimate knowledge of the working and manufacture of boilers and for scientific treatment of steam boiler problems. Those who have been wise enough to bind into volume form his reports will agree with us that they are wells of information from which one can never come empty away. General regret, then, will be inspired by the announcement that Mr. Stromeyer has written his last report as Chief Engineer of the Association which he has served so long. All engineers will hope that he will not cease to let them have the benefit of his great experience, and that in his retirement he will not devote his attention solely to those philosophical researches which his soul loves, but will still help his fellow-men in the humdrum business of making and working boilers.

Mr. Stromeyer's views on the strength of boiler materials have not always passed unchallenged, and he himself, like a true scientist, has not hesitated to modify them in the face of new facts. That the opinions which form the basis of his farewell report will escape criticism is extremely unlikely, because they fly directly in the face of long-established practice. But that in itself is not necessarily a sound cause for the rejection of new ideas. It is, indeed, true of boilers as of many other things, that current practice is no more than the application of experience gained step by step over a prolonged period, and that, in consequence, there are inherently good grounds for believing it to be right. But there is a natural tendency for "experience" to move forward in straight lines, whereas the nature of circumstances may at times require that it should move at a quick or slower pace or even *per saltum*. For example, the rules for boilers designed to work at 100 lb. pressure may be of exactly the same order as those for a 70 lb. boiler. But as soon as a region of much higher pressures is entered, the old rules, based on the old step-by-step experience, may not only delay progress, but even give a sense of security which is unjustified. For years engineers have gone on increasing the thickness of boiler plates in the belief, based partly on experience and partly on mathematics, that that is the right way to meet increasing pressures. Now Mr. Stromeyer puts forward the opinion that they have been misled by the mathematicians and that many boilers would be just as safe, and in some respects even safer, were the materials thinner than those called for by the accepted rules. The whole thing turns upon the difference between elastic and plastic strength. About the former a good deal has been known for many years and upon it the rules for boilers are founded. But about the plastic strength of materials we are only just beginning to acquire knowledge. We do know, as Mr. Stromeyer points out, that structures which ought to have failed long ago seem, in fact, destined to last for ever. Even amongst boilers there are numerous known cases, and no doubt thousands unknown, in which the factor of safety has fallen well below unity, and yet failure has not occurred. We are beginning now to understand that plastic deformation takes place, and that it, itself, causes the metals to acquire new physical properties. "Mathematicians," says Mr. Stromeyer, "treat materials as if they were perfectly elastic, like glass, whereas mild steel is not only plastic, but has the wonderful property of rewelding or reconstituting itself if overstrained. Therefore, although the mathematical theories are correct, they are only correct up to the elastic limit, and as not even a foundation has been laid for the mathematical treatment of plastic stresses, the impression has gained ground that if the stresses in a material exceed the elastic limit, and are therefore incalculable at present, it must be considered to have failed." Whilst both metallurgists and mathematicians may take some exception to the unqualified nature of this assertion, it remains true that all engineers endeavour to keep within the known elastic limits of the materials they employ. Furthermore, their tendency, when greater strength is required, is to seek for metals with ever higher elastic limits, so that they may keep their stresses below the assumed danger point. By so doing they may be plunging themselves into greater difficulties by surrendering the valuable plastic properties possessed by materials with what Mr. Stromeyer calls a lower "resisting power." To quote once more: "The knowledge which engineers have gained, and which is being added to by fatigue experiments, is that unknowingly they have been dealing with plastic stresses, and that if mild steel could not withstand them, most engineering structures would have failed long ago." Looking upon the design of boilers from this aspect of the strength of materials, it is obvious that the factors of safety in common use are unnecessarily high, or, in other words, that the weight and thickness of material used might be reduced without endangering the life of the boiler. But Mr. Stromeyer is careful to point out that whilst the factor of safety may be reduced considerably, that course should not be taken rashly. He suggests, and in that all engineers will agree with him, that any step of the kind should be preceded by one or two large-scale experiments, and that attention should be paid to the working conditions. We believe we are right in saying that it is now many years since, in any country, a boiler has been destroyed purposely under scientific control. Our knowledge, perforce, depends upon the reports of accidents, and they are always vitiated by the existence of indeterminate conditions. No one can doubt that a great deal of valuable information about boiler drums might be acquired by the test of a few to destruction under working conditions. We are entering an era of very much higher pressures, and the only way that we can see of meeting these pressures is to augment the "resisting power" of the material and increase its thickness. If Mr. Stromeyer's views are right, we may be advancing too

far in both directions, and in the search for a nominal factor of safety of four or five, we may be adding quite unnecessarily to both weight and cost. It is conceivable that as our knowledge of plastic properties increases, we shall find that the same factor of safety, or at any rate a perfectly adequate factor, could be attained by the use of a steel with a lower elastic limit and of less thickness. No better way of ascertaining the true facts and at the same time of removing the very natural uneasiness which is always caused by departure from accepted practices, could be found than progressive tests to destruction of a few steam drums. The alternative is to wait until fatigue, creep and similar tests which pass outside the elastic limit have provided the mathematicians with materials upon which new rules for the proportioning of boilers may be laid down. We suspect that in this, as in so many other cases, practice must precede theory, and that the quickest way of attaining to a useful mathematical expression will be to carry out experiments. It is admitted that we are on dangerous ground. Mr. Stromeyer himself says of his views: "I present them as being extreme possibilities, and, therefore, to be handled with caution; but," he goes on, "I am firmly convinced that if they are looked on as possibilities they will, step by step, effect an improvement in boiler design."

If Mr. Stromeyer spoke as one not having authority, it would be the easiest thing in the world to sweep his suggestions aside as revolutionary and dangerous. But when, as we all know, he speaks out of the fullness of knowledge, we are constrained to listen attentively to him. Steam boiler design is entering a new phase. Many new problems have to be worked out as pressures and temperatures are increased. It is not easy even to apply the familiar principles to some designs, and there is little doubt that already, in some cases, stresses above those which would be regarded as safe under the rules are exceeded. We are moving unconsciously, or at most only half consciously, towards a new method of treating materials and towards new theories of their working strength. We have already entered a field where mathematics fails us. The end has to be sought diligently by the old and despised plan of trial and error. Costly as that plan may be, it will in the end prove better than continuing on the old lines, without vision of possible changes, and waiting for a clear road. Mr. Stromeyer's suggestions are not idle speculations; they are based on a long experience, and it is very sincerely to be hoped that the examination of them will not be left to foreigners, but that they will be given in this country the thought and consideration and, above all, the practical trial which they deserve.

Ciment Fondu Concrete.

In a leading article which appeared in our issue of March 25th, 1927, we discussed an article which had been published shortly before that date in our contemporary, *Le Génie Civil*, and which was entitled "Observations sur une Maladie des Bétons de Ciment Fondu." The latter article was written by Messrs. E. Freyssinet and A. Coyne, the one a late engineer of the Ponts et Chausseés and the other at that time an engineer of that body. These investigators, both of them men of high repute, had set out to study certain anomalies, which had been noticed during the preceding autumn in connection with the construction of a bridge over the Elorn at Plougastel, near Brest, and in other structures in the same neighbourhood, in which Ciment Fondu had been employed. In the major portions of these structures the concrete was quite sound, taking on, after it had set, a dark grey colour lightly tinted with blue or brown, the grey-brown predominating after the concrete had been exposed for some time to the atmosphere. On being struck with a hammer it gave out a clear ring, and, on being broken, the fracture was clean and bold. But where defective concrete occurred it showed two colours: (*a*) a greenish blue black, which was unstable when exposed to the air; and (*b*) a reddish-yellow or dull earthy colour, which, when dry, turned to a clear earthy grey. The note given out under a hammer blow was dull and the fracture was coarse and rough. Samples cut from these defective portions were found not only to be very inferior in strength to the sound concrete, but to vary considerably from one another. Messrs. Freyssinet and Coyne had stated in their article that, in seeking to ascertain the reason for these anomalies they had satisfied themselves beyond any doubt that the defective parts were not the result of errors made on the site, such as the use of wrong proportions or different aggregates, nor of insufficiency or excess of water, or the use of dirty tools. Neither were they due to the quality of sand or gravel used. Furthermore, it was conclusively proved, (*a*) that materials taken from the same heaps had given both sound and defective concrete, and (*b*) that the cement itself was beyond suspicion. What they did find, however, was (1) that concrete or mortar made with Ciment Fondu experienced a very considerable fall in strength, accompanied by the characteristic coloration already mentioned, if the circumstances were such that the temperature after gauging could rise above a certain minimum, as, for example, when the materials were strongly heated by the sun's rays—as they had been when the structures containing the defective portions had been erected—and (2) that when sea water was used for gauging there was always a falling off in strength of some 50 per cent. as compared with concrete gauged with fresh water.

Now, in its issue for March 3rd last—nearly a year after the publication of the contribution of Messrs. Freyssinet and Coyne—there appeared in the columns of our contemporary another article on the same subject, entitled "Recherches sur la 'Maladie' de Certains bétons de Ciment Alumineux." That article is from the pen of Monsieur R. Feret, who is Chef du laboratoire des Ponts et Chaussées at Boulogne, whose opinions and work must certainly be regarded as highly as are those of Messrs. Freyssinet and Coyne. Yet Monsieur Feret arrives at conclusions which are, in one important detail, at any rate, entirely different from those of the other two experimenters. It is impossible for us here to follow him through all the tests which he carried out, though we would suggest to those who are interested that a careful study of his article would be well worth while. We must confine ourselves to dealing with one set of trials which he carried out, and which were made on a sufficiently large scale to lift them above ordinary laboratory status. Monsieur Feret took three samples of aluminous cements, which he designates B_1, B_2 and C. They came from two separate factories. With them he made mixtures containing 400 kilos. of cement to 400 litres of sharp natural sand and 800 litres of gravel. These materials were gauged with varying quantities of water so as to produce three series of concretes: (1) nicely plastic; (2) quite soft; and (3) fluid. The gauging was effected with both sea and fresh water; with materials both at atmospheric temperature, and heated; and the resulting concrete was kept under conditions varying as to surroundings, temperature and time, the samples being subjected to different physical tests and carefully examined after rupture. The results arrived at are set out at length in a detailed table. Discussing them, Monsieur Feret remarks:—"They plainly show that the lack of strength and the earthy appearance are due to an excess of gauging water and that the greater that excess the more marked they become, whatever the kind of water used for gauging and whatever the temperature during gauging and during the period of maturing." He adds that the excess of water with reference to the cement may be due to the use either of too wet a mixture, or of a mixture too rich in fine materials.

Here, then, we have two entirely different conclusions arrived at by experts of recognised standing when studying the same subject. On the one hand, Messrs. Freyssinet and Coyne find that the defect in the concrete was not due to excess of gauging water, but to the fact that the mingling took place when the temperature of the ingredients was too high. On the other hand, there is the statement of Monsieur Feret that the reduction in the strength of the concrete was caused by an excess of gauging water and that high temperature of materials at time of gauging does not have a seriously deleterious effect. There are other points of divergence, but sufficient has been said on the subject for our present purpose, though it may here be mentioned that all three observers note a diminution in the strength of Ciment Fondu concrete gauged with sea water as compared with that made from identical materials gauged with fresh water. A year ago we urged that, "just as close investigations had been made into the conditions which must exist in the use of metals, so, it would seem, should they be made into this phenomenon associated with the effect of heat upon a material which, owing to remarkable properties, is coming into more extended use." Now that there has been further investigation into the question, and since the results are entirely different from those originally reached by Messrs. Freyssinet and Coyne, the need for further and more searching inquiry appears to us to be increasingly imperative. No one would think of questioning the ability or the *bona fides* of such investigators as Messrs. Freyssinet, Coyne, and Feret, but the very fact that three men of such standing—two of them on the one side and one on the other—should, when testing the same, or an exactly similar, material, have arrived at such diametrically opposed results, emphasises, we suggest, not only the desirability, but, indeed, the pressing necessity for additional careful and systematic research. Such research should, in our opinion, be carried out, not only in the laboratory, but on an extended scale under ordinary service conditions and in varying climates. Only thus shall we learn how best to employ the valuable substance that Ciment Fondu undoubtedly is.

Literature.

The Water Supply of Towns and the Construction of Waterworks. By W. K. BURTON, Assoc. M. Inst. C.E. Fourth edition, in two volumes. Edited by J. E. DUMBLETON, Assoc. M. Inst. C.E. London: Crosby Lockwood and Son. 1928. Price per volume 25s.

THE first of these two large volumes relates to collection and purification works, and the second to works for distribution. The first contains thirty plates and, counting different views of a single subject, some 125 illustrations, the second ten plates and 114 such illustrations.

As stated in his preface to this edition, the editor has sought "to preserve the character of the original work and at the same time to embody the many improvements in detail which have resulted from numerous discoveries and inventions during recent years." Involving revision of descriptions not consistent with modern practice, the first object has been achieved, the work remaining a sound and commonsense treatise on the subject, and including interesting matter relating to Japanese practice. The editor has not so fully attained his second object, the nature of which is not completely disclosed, however, having regard to the significance that may be assigned to the definite article and, in limitation, to the last word in the phrase "the many improvements in detail." Such additions by no means extend throughout the work. One finds the particular contributions to which the editor calls attention, relating to the purification and softening of water, to rapid filtration and to pumping machinery, as well as some other cases of useful additions; but elsewhere matter needed to bring the subject up to date is meagre or lacking. This remark applies to some important classes of structures as well as to such discussions as would present modern practice, however briefly, and include consideration of recent data. In some cases the unbridged gap is a wide one.

The work may be considered in three aspects: as the original and still valuable elementary and practical treatise; as the same, brought up to date, in some respects, by the editor; as failing to present adequately and in the light of recent experience some important parts of the subject. In the first aspect there is the very good chapter on the different qualities of water, the taking of samples for analysis, impurities and hardness. The discussion of the quantity of water to be provided is useful and the recommendations made are sound, while in regard to storage the text and diagrams provide a good basis for further study. The classification of waterworks is explained in a very elementary manner, with diagrams, this treatment being of the class-room kind; but of little interest to waterworks engineers. Similarly, the subject of the depths of impounding reservoirs is treated in a sound elementary manner only. The same restriction of scope is found in the chapter on earthwork dams, the matter being suitable and sufficient for preliminary instruction. Masonry dams, considered as types, receive very careful attention, excellent drawings being furnished, including examples of the designs of Molesworth, Wegmann, and Rankine. As a basis for the further study of mass gravity dams this part of the work is very good. There is also good introductory matter relating to the purification of water, pumping plants, the flow of water in channels and pipes, and the nature and use of cast iron pipes. The distribution system is usefully discussed in respect of the management of a water supply. Owing to the occurrence, in recent years, of earthquakes of considerable severity, in regions previously immune from such visitations, the appendix on earthquakes is of greater importance than it was when the first edition of the book was published.

In its second aspect, as partially brought up to date, the book adequately presents some important parts of the subject. There is a good general discussion of settling reservoirs, with notes on design and construction, illustrated by scale drawings. The chapter on sand filters is a good one, while that on rapid filters and water softening may also be commended. The nature and purposes of service reservoirs are well explained, but the only designs of water towers illustrated are a structure of cast and wrought iron at Shanghai and the Liverpool example of a

wrought iron "dish" supported by a masonry tower. The prevention of waste and the use of meters are usefully discussed, Deacon's methods being described and his diagrams reproduced, while praise may also be accorded to the illustrations of meters and of various other appliances, supplemented in the advertisement pages.

There remains to be considered the third aspect of the work, as one partially failing to present the subject in the light of sound practice, including that of recent years. A conspicuous example is afforded by the matter relating to the measurement of the velocities of streams and channels. The slices of turnip, recommended as floats, embody a useful principle, but one in the application of which many precautions, not mentioned in the book, must be taken. Measurements such as those made with rod floats are not considered, nor the significance of the curve of velocities to depths. It is considered good enough to take the mean velocity as three-quarters of the surface velocity, regardless of the kind of stream which is being measured. Reference is made to current meters and to the Pitot tube, but without information as to their forms or instructions as to their use. For cases in which the stream has not been gauged the probable variations of flow are inadequately indicated by a single table. There is no discussion of estimation from rainfall data, nor of run-off ratios generally. Similarly, in regard to storage capacities, one table, based on an invariable coefficient of run-off, is furnished. Data are lacking respecting reservoir capacities, no tables of depths-volumes or depths-areas being provided.

The chapter on earthen dams, already noted as being satisfactory up to a point, is not extended to include discussions of problems arising in connection with such dams, difficulties encountered, or leakage, nor of the various designs intended to suit particular conditions at sites. There is no reference to concrete core walls, nor is any preference expressed for the placing of the outlet tunnel in the solid ground beyond the dam. The treatment of weirs is very slight. A single table is furnished, giving, for catchments of different areas, the corresponding lengths of weir and depths over the weir; but it is stated that for Japan the halves of the areas should be taken, owing to the severity of the rainfall. The significance of this fact in relation to the question of the general suitability of the table is ignored. Design of weirs from rainfall data is not considered. The practice of building a temporary dam of earth and sods on the weir, to avoid waste of capacity, is described, with the alternatives of baulks of timber for short weirs; but gates are not mentioned. The treatment of the subject of masonry dams is, except for a description of one form of buttress dam, confined to the sound but old matter already mentioned. References to modern gravity dams curved in plan hardly go beyond the quotation of conclusions relating to the Quaker Bridge Dam and the citation of the elementary formula. Mention is made of the Stevenson Creek experimental dam, but neither the single-arch nor the multiple-arch type is described or discussed. Less than a page is devoted to the materials and construction of masonry dams. The editor was faced with difficulties greater than those usually encountered in such a case, the most formidable being the changes which, since the first edition was published, have taken place in respect of the relative importance of different parts of the subject.

Modern Electrical Illumination. By CYRIL SYLVESTER, A.M.I.E.E., A.M.I. Mech. E., and THOMAS E. RITCHIE, A.M.I.E.E. London: Longmans, Green and Co., Ltd. 1927. Price £2 2s.

THE authors of this interesting and informative book are, curiously enough, both of them chief illuminating engineers to competing British firms, engaged in the manufacture of electrical machines, apparatus, lamps, &c. It might be foretold that such a partnership of rivals would naturally tend to lessen the likelihood of such a work as the present being employed for advertising purposes. If that were the object aimed at, it has certainly been achieved, for there is practically nothing in the nature of direct advertisement of any particular thing or system from cover to cover of the book, which is, as a matter of fact, a storehouse of useful information, of an entirely impartial character.

The authors have dealt with their subject from many points of view. They begin with the human eye, which they describe and illustrate anatomically, and continue with the effects of light and colour upon it. To these portions of the subject they devote twenty-six pages. Then, after a brief discussion of "Light Control and Shadows," they pass on in Chapter III. to "Industrial Lighting," which they consider under the following headings, among others: —Lighting designs; types of reflectors; polar curves of controlled and uncontrolled light; effect of incorrect spacing; watts per square foot method of calculation; lumen method of calculation; lumen values of vacuum and gas-filled lamps. The text is illustrated with half-tone engravings and excellently prepared graphs. Chapter IV., which runs to some 70 pages, is concerned with "Lighting Designs for Shops and Stores," and the subject has been dealt with in a thoroughly practical manner, much thought and study having, evidently, been given to it. Examples of good and bad window illumination are given by means of engravings to emphasise the points brought out in the text, and the chapter will undoubtedly be very useful to all concerned in shop and store illumination, whether they be proprietors or those whose business it is to provide the lighting installations. It contains, for example, a lengthy table setting out the numbers of foot-candles recommended for different classes of shops, stores, schools, public buildings, &c.

The difficult subject of "Street Lighting" is ably dealt with at length in Chapter V., and the next—a short chapter—discusses "Motor-car Headlight Illumination." The next chapter—on "Flood Lighting"—will be read with considerable interest, since it explains very clearly how much has been done with this newer method of illumination which is rapidly becoming more and more popular. Chapters VIII., IX., and X., devoted to "Domestic Lighting," "Public Buildings, Pleasure Gardens and Seaside Resorts," and "Theatres, Cinemas, Clubs, Hotels and Dance Halls" respectively, are all of them well worth careful study, especially by those who are seeking aid in the lighting of such buildings as the last named.

The presence of Chapter XI. is rather difficult to explain. It contains a description of the manufacture of vacuum gas-filled lamps, and though, of course, such lamps are largely—in fact, almost entirely—used in the different systems of illumination described in the book, there does not appear to be sufficient reason why a chapter on their manufacture should be included in a work of this kind. There the chapter is, however, and it cannot be denied that it affords good reading.

Chapter XII., on "The Art and Science of Stage Lighting," introduces a subject which has during recent years made great strides, and explains many things about which but little is generally known. Chapter XIII. treats of "Electric Signs and Train Lighting"; while the final chapter—XIV.—discusses miscellaneous subjects, such as cathedral lighting, special lighting units, light control, antique lighting units, temporary outside lighting; drawing-office lighting, office lighting, and illumination data.

The volume throughout is eminently practical and the English is good. It is well got up, well printed, well illustrated, and well indexed, and it will, we think, prove to be a useful addition to the literature of the subjects with which it deals.

BOOKS RECEIVED.

Automobil-Reparaturen. By O. Winkler. Halle (Saale): Wilhelm Knapp. Price 9·50 marks.

Drang und Zwang. By Dr.-Ing. A. Föppl and Dr. L. Föppl. Munich: R. Oldenbourg, Glückstrasse 8. Price 17·50 marks net.

Kesselanlagen für Grosskraftwerke. By Dr.-Ing. F. Münzinger. Berlin: V.D.I. Verlag, Dorotheenstrasse 40, N.W. 7. Price 19 marks net.

The Colliery Year Book and Coal Trades Directory, 1928. London: The Louis Cassier Company, Ltd., 22, Henrietta-street, W.C. 2. Price £1 1s. net.

Theorie der Reduktionsfähigkeit von Steinkohlenkoks. By Prof. Dr. G. Agde and Dr.-Ing. H. Schmitt. Halle (Saale): Wilhelm Knapp. Price 16·50 marks.

Sell's Directory of Registered Telegraphic Addresses, 1928. London: Business Directories, Ltd., 869, Johnson's-court, Fleet-street, E.C. 4. Price 45s. net.

Commercial Electrical Measuring Instruments. By R. M. Archer. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

The "Journal" of the Institute of Metals, No. 2, 1927. Edited by G. Shaw Scott. London: The Institute of Metals, 36, Victoria-street, S.W. 1. Price 31s. 6d. net.

Light Metals and Alloys: Aluminium, Magnesium. Washington: United States Government Printing Office, Department of Commerce, Bureau of Standards, U.S.A. Price 1·10 dollars net.

Obituary.

LEE MURRAY.

AMONGST the very many who knew Lee Murray in Australia, South Africa and Great Britain, there must be few indeed who will not hear of his death on Tuesday last with real sorrow. He was one of those men who have a natural aptitude for making friends, and in Australia, the land of his birth, as in South Africa and in this country, he was known to a large number of men, not only as a brother engineer but as a familiar companion. We recall that a few years ago when he was prostrated by a severe illness and was advised by his doctor to visit the Cape for a time to restore his health, many of his friends offered him a farewell dinner, thinking with him that he would settle down in the more congenial atmosphere of South Africa. But in a short time he had made such a good recovery that he was able to return to this country, and though he had to deny himself the pleasures of the great pipe from which at one time he was inseparable, he appeared to enjoy almost normal health. It is the greater grief that he should have died at the relatively early age of sixty-three.

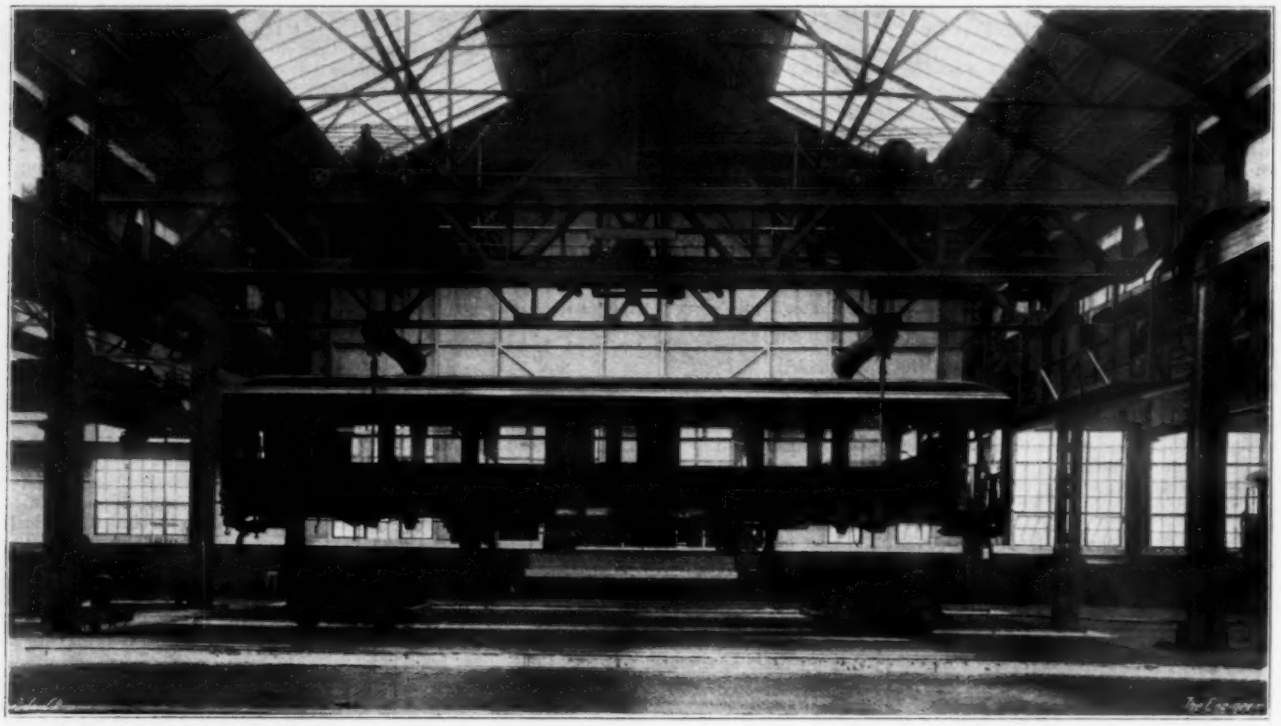
Lee Murray's work was carried on mainly in the field of electrical engineering, and he acted in this country as the adviser and consulting engineer of Australian and South African purchasers. But when we look back over the many years in which we knew him, it is that period in which, with a few good friends, he was, in his own way, endeavouring to smooth away the differences between capital and labour which stands out most distinctly. At that time he was the perpetual chairman of a little company of diners who met from time to time in an upper room at the Eccentric Club and talked over pipes and tankards of ale—in which Lee was a staunch believer—of industrial affairs. Around the table might be seen some who, in that field, could only be described as thinkers, but there were often others who were employers, and there were always one or two, sometimes more, Labour leaders. Under the genial chairmanship of Murray, known to nearly all simply as Lee, it was impossible for the debates which followed the dinner, to be anything but friendly, and it may safely be said that at that critical time the exchange of views, between men with diverse opinions, which took place on those occasions, did not a little—we shall never know how much—to bring both parties to a better understanding of each other. It is perhaps inevitable that such things should grow, that they should not be allowed to carry on their useful work in an unassuming way. That was the fate of Lee Murray's parties. They grew from friendly little affairs at which every one knew every one else into an ambitious body called the Industrial League. It found itself duplicating the work of the Industrial Council. An amalgamation was formed, and for a time the Industrial League and Council, as it was called, seemed to flourish. But the essential spirit of friendship had gone out of it; the little dinners became huge banquets, with reporters of the Press present; it essayed to have political influence; it spent a deal of money on publicity, and finally it perished under its own weight, and has not been heard of for years. Whilst there were many who regretted the line it took, there were none, we are confident, more sorry than Murray himself. We do not know how much of the other work that he did will live in the minds of men, but of this we are certain, that the little body of men who helped him or enjoyed the hospitality of his table at these gatherings, will keep the memory of them and of him with them to the end.

SIXTY YEARS AGO.

IF the financial position of our railways to-day cannot be regarded as wholly satisfactory, it is certainly a good deal better than it was sixty years ago. In the late 'sixties few British railways were able to earn dividends and some of them were bankrupt or very nearly so. The position had become so acute that, writing in our issue of March 27th, 1868, we referred to British railway property "stinking in the nostrils of the capitalist and the honest speculator." We addressed ourselves to the task of discussing why the railways did not pay and developed what we believed to be a novel argument. Previously all writers and speakers on railway economy had concentrated on the fact that the capital expended on the railways had been so great that the profits earned when distributed among the shares represented an infinitesimal percentage. Our argument was that the profits were small because the working expenses were so very large. A very moderate reduction in the working expenses, we pointed out, would be tantamount to a very fair dividend. The enormously high working expenses were in part caused, so we argued, by the fact that the deadweight transported by the railways was out of all proportion to the paying load. A recent parliamentary return was quoted to show that about 25 tons of deadweight were used in carrying each ton of passengers. In a specific instance, that of the Metropolitan Railway, an undertaking enjoying the largest passenger mileage in the kingdom, an average train consisted of five 16-ton carriages and a 42-ton engine and carried on the average sixty passengers. The deadweight, therefore, consisted of more than 2 tons per passenger carried. Omnibuses, including the horses, we remarked, showed a deadweight of not more than three times the paying load. In the case of a goods train we found that the deadweight, including the wagons, engine and tender, amounted to about 1½ tons for every 2 tons of goods carried. Why, we asked, was passenger-carrying rolling stock so enormously heavy? It could not be maintained for a moment that it was as light as it could possibly be made with safety. The money wasted in hauling the deadweight about the country would, we asserted, pay a good dividend. The first carriages used on our railways were of light construction and were hauled by light engines. Their use was abandoned, we believed, because heavier carriages were run with them in the same trains and because these heavy carriages and the heavier engines introduced to draw them knocked the light carriages to pieces in shunting operations. It had never been shown that the heavier carriages were really essential. Nearly all existing carriages were immensely too strong. By reducing their weight engines lighter than those in use could be employed, less fuel and water would be used, and less damage would be done to the permanent way. We felt no doubt that the change would ultimately be effected. A modern Southern Railway electric trailer coach seating ninety passengers has a tare weight of 23 tons, while a motor coach holding eighty passengers weighs 40 tons. A unit consists of two motor coaches and a trailer, and a "rush-hour" train is made up of two units with two additional trailers. A rush-hour train therefore weighs 252 tons and can seat 680 passengers, and represents about 5½ tons of dead load for each ton of paying load. A three-coach unit running with 25 per cent. of its seating accommodation occupied represents about 57 tons of dead load for 1 ton of passengers.

30-TON OVERHEAD TRAVELLING CRANE LIFTING RAILWAY COACH

S. H. HEYWOOD AND CO., LTD., REDDISH, NEAR STOCKPORT, ENGINEERS



30-Ton Duplex Overhead Travelling Crane.

AN interesting and in some respects unique overhead travelling crane has recently been built by S. H. Heywood and Co., Ltd., Reddish, near Stockport, for the London Underground Railways, to the specification and special requirements of Mr. W. A. Agnew, chief mechanical engineer of the system, and the crane is now at work in the lifting shop of the railway car repair works at Acton. In the half-tone engraving at the head of this article it is seen lifting one of the railway coaches. The crane is of the duplex pattern, and is designed to lift a load of 30 tons.

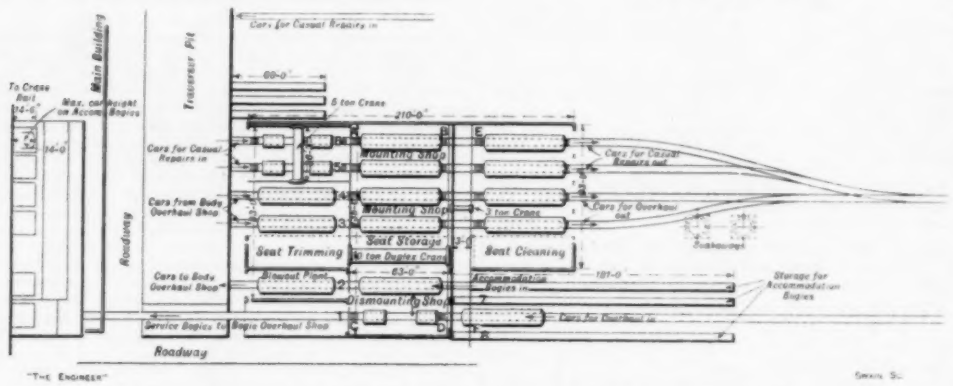


FIG. 1—PLAN OF THE UNDERGROUND RAILWAYS CAR REPAIR SHOP AT ACTON

A plan of the arrangements made by the railway company for effecting the repairs and maintenance of the cars on its system is shown in Fig. 1. It will be observed that the arrangements are quite novel. The Heywood crane operates over the area shown by the rectangle A, B, C, D. The cars to be overhauled come in along the track No. 1, seen in the lower right-hand corner of the plan, and pass into the area served by the crane. Each car as it arrives is lifted by the crane, and the service bogies, which are thus freed, are first of all drawn away to the bogie overhaul shop on the left-hand side. The car is next carried away by the crane in the direction of the arrow until it comes over the nearest parallel track No. 2, along which accommodation bogies are run in the correct positions beneath the car for the latter to be lowered upon them. The car is then run into the blow-out chamber—seen to the left of the dismounting shop in the plan—where its electrical equipment is subjected to a thorough cleaning down by means of an induced draught apparatus and blasts of compressed air directed from portable nozzles. The car is then again moved to the left on to an electrically-driven traverser, and is transported to the lines leading to the body overhaul shop.

In the meantime cars which have been overhauled are coming from the body overhaul shop on the traverser and are delivered on to tracks 3 and 4, again coming under the 30-ton crane. Each car is then lifted up in turn, the accommodation bogies are run from under it, and service bogies are placed in position and on to them the car is finally lowered. The overhauled cars move out to the right as shown on the plan.

A 3-ton crane by the same makers operates over the whole of the rectangle B, D, E, F—Fig. 1—and is employed in returning the accommodation bogies which are no longer required to the storage tracks 7 and 8, lifting the accommodation bogies on to track No. 1 for the use of each car as it comes in for overhauling, and for handling and rearranging the accommodation bogies on their tracks as may from time to time be required.

There is shown on the upper portion of the plan a track along which cars for casual repairs come into the works. These in turn are brought by the agency of the electric traverser on to tracks 5 and 6, where they are handled by the 30-ton overhead traveller. For these two particular tracks there is another "Heywood" crane of 5 tons capacity. The arrangements are such that the large crane can pick up any car and lift it if necessary over any other standing car in the building, and transport it to, or from, any one of the tracks marked 1, 2, 3, 4, 5, 6 on the plan.

The 30-ton crane has a span of 63ft. and weighs approximately 36 tons. It carries two crabs, each designed to lift a load of 15 tons. Each crab is fitted with two rope drums driven simultaneously by a 24 B.H.P. motor running at a speed of 600 revolutions per minute, the hoisting ropes being connected to the lifting irons which hook under the framework of the cars. The two crabs are so interconnected as to get synchronisation of the two hoisting motors when desired, in order that the two ends of a car may be lifted simultaneously at equal speeds. This mechanical interlocking is obtained by coupling the hoisting motion of one crab permanently by means of bevel gears to a square shaft which runs the full length of the crane, the other crab being clutched to this shaft, or declutched, at will by means of a solenoid-operated claw clutch. The hoisting motion is primarily controlled by means of two tramway type controllers in the driver's cage, the controllers being arranged for independent or simultaneous operation as required.

One of the crabs is illustrated in Fig. 3, which shows, among other details, the two rope drums, the hoisting motor, the solenoid-operated clutch, and the square shaft with its bevel driving gears and tumbler bearings. A special compensating gear is mounted beside each rope drum in such a manner that when the pull on either rope exceeds, by a small amount, that required to raise the lifting irons, the compensating gear will move downwards far enough to close a relay switch connected mechanically to each compensating gear.

The operation of lifting is as follows:—The lifting irons are held in place under the car body by the slingers, and the crane driver, having first coupled the hoisting controllers together, both mechanically and electrically, by a simple apparatus, moves the controller handle on to the first notch. As each pair of lifting irons comes into contact with the underframe of the car, the corresponding motor is stalled, because the torque developed by the motor on the first notch of the controller is only greater by a small amount than that required to lift the lifting irons alone. The pull, however, is sufficient to operate the special compensating gear and close the relay switch described above. The closing of the relay switches—provided always that the controllers are coupled together at the time—brings into operation the contactor gears, one contactor energising the solenoid-operated clutch, thus mechanically coupling the two sets of hoisting gears together, while the other contactor cuts out sufficient of the series starting resistance to increase the torque developed by each motor to approximately 60 per cent. of full load torque. It may be pointed out that if the two controllers are not coupled together, the torque developed on the first notch is never less than 60 per cent. of full load torque, and also that the closing of one or both relay switches has no effect upon the opera-

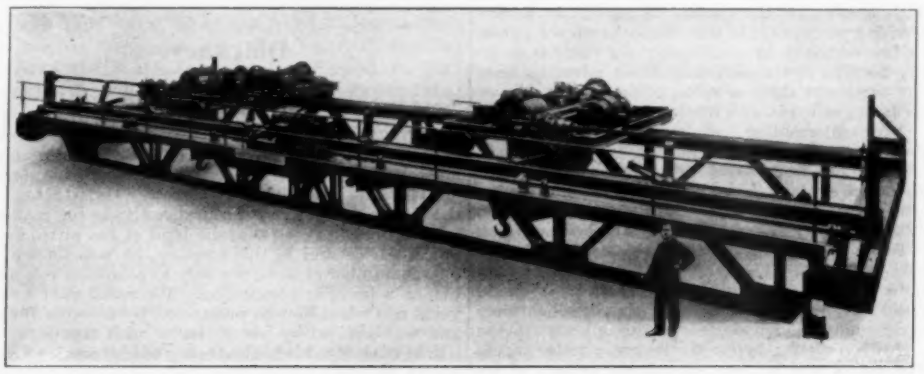


FIG. 2—GENERAL VIEW OF CRANE AND CRABS

tion of the gear when the controllers are uncoupled.

In order to get dead slow lifting, a portion of the armature current is shunted through a variable resistance on the first few notches of the controller, so that the lifting irons can be brought up to the underside of the car body and the car lifted at the slow speed of about 2ft. per minute.

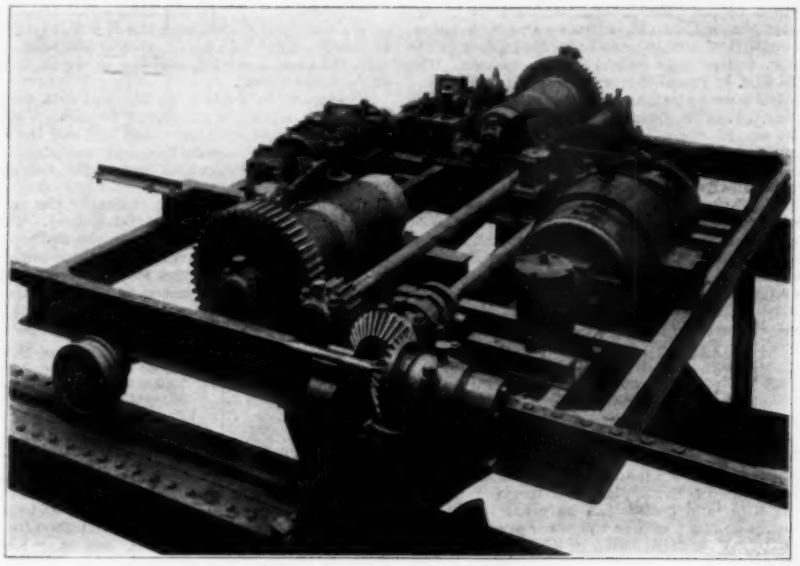


FIG. 3—ONE OF THE CRABS OF 30-TON OVERHEAD CRANE

The two crabs are shown in position on the crane in illustration Fig. 2.

The full load longitudinal travelling speed of the crane is 250ft. per minute, the crane being driven by a 24 B.H.P. motor, but in the interests of safety it has been made impossible for the crane to be travelled at a higher speed than 40ft. per minute, unless the empty lifting irons are hoisted up to such a height as to pass safely over standing coaches. If there is any load on the lifting irons the high travelling speed cannot under any circumstances be obtained. This result is secured by the action of a height-limiting switch driven mechanically by the hoisting rope drum, which switch, acting in conjunction with an additional relay switch operated by the load on the lifting irons, opens a relay circuit actuating a contactor gear which cuts out the series and armature diverter resistance from the travelling motor circuit when the empty lifting irons reach a given height.

With the electrical equipment of the travelling motion as so far described there would exist the danger that, when the crane was travelling at its highest speed with the lifting irons light, the lowering of those lifting irons past a point at which the height limiting switch cuts in, would cause the contactor gear to throw the series and armature diverter resistances into the motor circuit, which would exert a very great and sudden braking effort on the motor. This danger has been obviated by driving a small generator from the travelling motor pinion, and coupling the generator up to contactor gear in such a manner that, when the crane is travelling at a high speed, the rising voltage of the small generator operates the contactor gear and cuts the main current from the hoisting motion. The illustration—Fig. 4—shows the longitudinal travel motor and gearing, the brake which is operated by means of a foot brake in the driver's cage, and also the small generator which automatically cuts out the hoisting motion when the crane is travelling at a high speed.

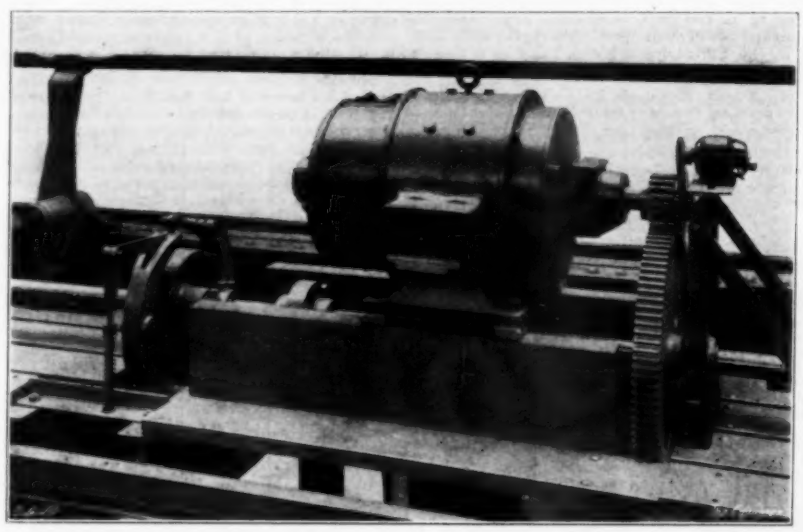


FIG. 4—LONGITUDINAL TRAVEL MOTOR AND GEARING, AND BRAKE

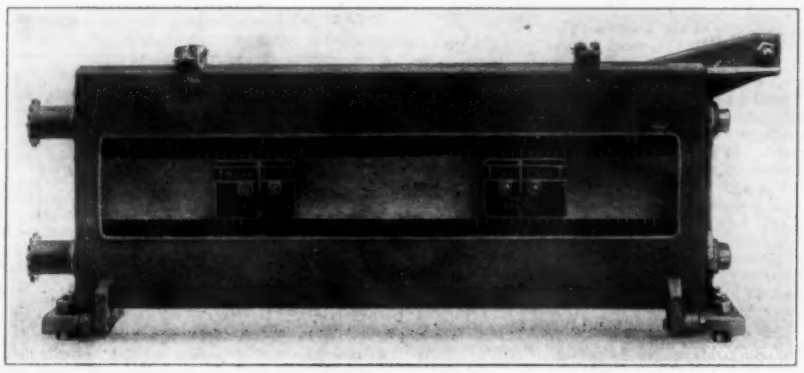


FIG. 5—CRAB POSITION INDICATOR

At each end of the main track there is a skate which actuates a series limit switch which is carried on one end carriage of the crane. It has not been found necessary to interlock the movement of the two crabs, but there is fixed in the driver's cage an indicator which shows the exact position of the two crabs on the crane girders. This indicator is illustrated in Fig. 5.

To prevent an inadvertent collision between the two crabs each is provided with a skate and limit switch, both switches cutting off the current from the cross-traverse motor and applying the electric brake shown in Fig. 2. The brakes effectually prevent the crabs striking one another in any position on the girders. There are also series limit switches arranged to cut the current off the cross-traverse motors and apply the brakes before the crabs strike the stop blocks at either end of the crane girders.

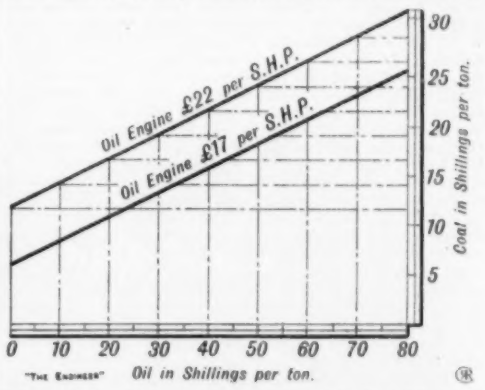
The Question of Fuel for Ships.*

By SIR JOHN H. BILES.

IN April, 1925, and in June, 1926, I had the honour of presenting for the consideration of the members of this Institution the subject of the "Relative Commercial Efficiency of Steam and Internal Combustion Machinery for Ships."

Lloyd's Register Returns at the end of June, 1927, and of June of each of the two preceding years show that in the relative states of the three types of machinery:—(1) Coal fired; (2) oil fired; (3) oil engines, there had been a falling off of 1·6 per cent. in tonnage of ships having reciprocating, and an increase of 1·4 per cent. in turbine and 57 per cent. in oil-engine ships. During these three years the new ships launched have changed as follows:—Reciprocating reduced 55 per cent., turbines increased 48 per cent., oil engines increased 30 per cent. The total new tonnage of coal-burning ships built has decreased 55 per cent., the oil-using ships have increased 4½ per cent., the total new tonnage built having decreased 26 per cent.

The use of the water-tube boiler was looked upon with suspicion when my paper was read in 1925. Since reading the 1925 paper the "King George V." has been built, fitted with 550 lb. pressure boilers, coal fired, and has been running successfully for a whole season on the salt water of the estuary of the Clyde. Mr. John Johnson, the superintending engineer of Canadian Pacific Steamships, Ltd., has had the courage to recommend, and the good fortune to secure, the adoption of water-tube, coal-fired boilers of 250 lb. pressure in connection with Parsons turbines, and these installations have been successfully running in the "Beaverburn" and other similar ships. Other ships of this line are to be fitted with turbines of 20,000 S.H.P., water-tube boilers, oil fired, 370 lb. pressure, and 250 deg. superheat. Mr. Visker, the superintending engineer of the Nederland Stoomvaart Maatschappij has applied high-pressure steam to a triple engine. The boiler pressure is 500 lb. superheated to 750 deg. With mechanical stokers the consumption is 1·13 lb. per I.H.P. for all purposes. The "Ile de France" has 52,000 S.H.P., and has boilers of the type referred to in my 1925 paper as Howden boilers, which are mixed fire-tube and water-tube boilers. It is claimed that they have 10 per cent. more efficiency than a cylindrical boiler. The s.s "California" has about 14,000 S.H.P. with water-tube boilers working at 275 lb. pressure and 120 deg. superheat. The P. and O. are reputed to have given a lead to the ocean-going ships of this country by adopting electric transmission instead of mechanical between the steam engine and the propeller shaft. This machinery consists of water-tube boilers of 400 lb. pressure driving steam turbo-electric generators of high revolutions. In the Bauer-Wach system of using a low-pressure turbine geared to a triple engine a gain of 20 per cent. of economy has been claimed, and the system has been adopted in many triple ships. The Germans are reported to be building two new "Aquitania's" having water-tube boilers of 350 lb. pressure with turbine machinery. One firm of water-tube boiler-makers has fitted forty-two sea-going vessels during the last three years with over 120 boilers.



Prices of Coal and Oil in order that the Sum of the Cost of Coal and Charges Based on First Cost of Machinery shall be Equal to the Sum of the Cost of Oil and Charges.

In an oil engine we may assume that one S.H.P. can be got for not less than 0·4 lb. of oil per hour, and that with oil at £4 per ton, 1 lb. of oil will cost 0·43 of a penny, so that one S.H.P. costs 0·17 of a penny per hour for fuel oil. Assuming that the ordinary reciprocating engine with cylindrical boilers of 200 lb. pressure requires 1·7 lb. of coal per S.H.P. per hour, and that coal is 24s. per ton, then 1 lb. of coal will cost 0·13 of a penny, and one S.H.P will cost 0·22 of a penny. We may assume that the oil engine costs at least £22 per S.H.P. in this country, and the ordinary triple-expansion costs £10 per S.H.P., and that each works 200 days per year, and that the total annual charges are spread over these 200 days. The depreciation, interest, and insurance per hour works out at

* Institution of Naval Architects, March 28th, 1928, abridged.

0·09d. per S.H.P. hour for the triple, and 0·2d. for the oil engine. The diagram on page 355 shows the price that coal should be per ton for any price per ton of oil, in order that the sum of the cost of fuel and the interest, depreciation, and insurance on the first cost of the machinery shall be the same. If oil is presented "free gratis, and for nothing," to the oil shipowner, the coal-burning shipowner can afford to pay 12s. per ton for his coal, and still his fuel and charges will cost no more than those of the oil engine. With oil at the standard price of 80s. the figure for coal may be 30s. With oil at 30s. the corresponding figure for coal may be 19s.

These two items, fuel and 18½ per cent. for charges, do not constitute the whole of the costs. The total costs were dealt with very fully in my two earlier papers, but the masses of figures there involved do not lend themselves to ready and easy discussion. Further, the difference between the high-pressure and temperature installation and the oil engine in the cost of the other items dealt with, viz., lubricating oil, wages, food, and fresh water, amounts to about 1 per cent. of the total cost in favour of the oil engine. This quantity, about £350, may be kept in view in the estimate of total cost of running, but an effective comparison between the most efficient steam and oil engines can be made without it. (See Table III.)

The triple-expansion engine, with the dirt of its coal and the hard work of its firemen, does not compare in ease and comfort at sea with either the oil-fired boilers and the turbine or with the oil engine. The liquid nature of oil causes it to be more easily handled both in port and at sea. Shorter time in port, and consequent greater profits, where profits can be made, and smaller machinery crews are the results. These advantages may be very considerable, especially in the case of periodic services, where a quicker turn round may enable a schedule to be maintained with a smaller number of ships. It is not easy to evaluate this advantage in terms of cost of running per S.H.P. between services which are coal burning and oil burning respectively, but it is evident that where reductions in the nature of 25 per cent. in the number of ships employed to do a given service are made by the use of oil instead of coal such use is fully justified.

The question arises: What is the best form of machinery in which to use the oil; second, can any means be adopted to make coal so liquid that the advantages stated above can be as readily obtained as with oil.

It may first be remarked that in similar machinery supplied by steam from boilers, coal fired, as compared with oil fired, the relative B.Th.U.'s of the oil and the coal measure the quantity of fuel used and the amount of boiler power necessary. Assuming the relative B.Th.U.'s to be 13,600 and 19,000, it is evident that the oil firing is more costly when the cost per ton of oil is more than 1·4 times the cost of coal. That is, oil must be not more than 28s. per ton to compete with coal at 20s. per ton.

There is some advantage in the oil-fired installation, as the weight and space occupied may be $\frac{1}{1 \cdot 4}$ times that of the coal-fired, *i.e.*, about 28 per cent. of the boiler space, fuel, and weight may be saved.

In the case of an intermediate passenger turbine steamer, 550ft. long, having 10,000 S.H.P. with cylindrical oil-fired boilers (200 deg. superheat), in order to do the same work with coal firing it will be necessary to carry extra boiler power and to have extra coal space, and to do so it will be necessary to increase the length of the ship 46ft. if the other dimensions are not altered. A typical Atlantic vessel of this size would carry about 1650 tons of oil, and if enlarged to use coal instead of oil would require about 2300 tons of bunker space to steam the same distance. The extra weight of hull, boilers and coal would be about 2100 tons. If the displacement is enlarged in proportion to the length, the increase will be 1900 tons. If we put it all in amidships, it would be 2400 tons, so that it seems to be quite a practicable proposition by increasing the length of the ship to carry the same weight of cargo, stores, &c., and sufficient coal to steam the same distance as the shorter ship could steam when burning oil. The net result is that the ship would be increased 46ft. in length and would cost about £70,000 more. The difference between the cost of the coal and oil per year in the two cases would be about £35,000, while the charges on the extra cost of the ship would be about £14,000, so that the coal-burning ship is £21,000 per year better than the oil-burning ship. Therefore, the whole economic advantage of burning oil in this type of ship depends on the ease with which the oil can be put on board and used on board.

So much for the comparison between coal burning and oil burning for ships with steam cylindrical boilers, ordinary turbines and 200 deg. superheat. The next comparison may be made between steam machinery using coal or oil and the oil engine. Table I. gives ample opportunities of studying this question.

First, we may take the "King George V.," which has passed the experimental stage of the use of steam of 550 lb. pressure and 700 deg. of temperature and the consequent use of water-tube boilers. The consumption of coal of 13,880 B.Th.U.'s has been proved to be 1·085 lb. per S.H.P. hour. In the turbine one S.H.P. was produced for 8 lb. of water evaporated, and the auxiliaries required 1·66 lb. The efficiency of the boilers was 79 per cent. The figure 1·085 lb. per S.H.P. hour may be converted to one in which oil of 19,000 B.Th.U.'s is used, and will be equivalent to not more than 0·79 lb. of oil in a plant of 3600 S.H.P. Of this oil consumption 0·65 lb. is due to the turbine and 0·14 to the auxiliaries. In the "King George V.," in which the above figures were obtained, the coal was hand fired.

Mechanical grates have been adopted in some recently built vessels; but whether the exact value of these grates in terms of coal per S.H.P. has been accurately determined and can be made known may perhaps come out in the discussion.

There seems to be a prevalent opinion that to obtain the highest efficiency in a boiler, the air heating must not be limited to the extent that it has to be with mechanical grates, and therefore that for the highest boiler efficiency fuel must not be burnt on a grate but in a pulverised condition.

Can any approach in ease of handling coal be made to that of oil? The changes that have to be made from existing practice are first in getting the coal on board and second in causing it to reach the furnaces in a steady stream. Captain Brand, in his paper read at our last summer meeting in Cambridge, proposed to supply the ships with low-temperature distillation residue in a powdered form through pipes, suggesting precautions in bunkering to reduce the chance of explosion of the powdered fuel. Others have proposed supplying the fuel in a small enough size to enable it to be pumped to the bunkers, from which it would be man-handled or machine-conveyed to crushers, and from there to pulverisers, from which it is blown, suitably mixed with air, into the furnaces and there burnt. This latter method of burning has been used freely in the United States, and to some extent in this country. The report of the U.S.A. Prime Movers Committee for 1926–7 shows that 203 power stations using powdered coal with boilers larger than 5000 square feet, say, 2000 H.P., are in operation.

In this country there appear to be no published figures of a similar character; but it may be remarked that the Electricity Board have authorised 775,000 kW, say, 1,000,000 H.P., of new or extended power stations during 1926–7. A great part of this power is to be developed by pulverised coal, and practically all by water-tube boilers.

The following figures, taken from *Power Plant Engineering*, December 15th, 1927, give a characteristic record of progress in a particular plant in the United States.

1902	Scotch boilers	Hand fired	15,000 lb. steam per hour each
1908	Water-tube boilers ..	With chain-grate stokers	23,000 lb. steam per hour each
1916	Water-tube boilers ..	Underfeed stokers	33,000 lb. steam per hour each
1925	Water-tube boilers ..	Pulverised fuel, but rearranged furnaces ..	50,000 lb. steam per hour each
1927	New boilers	Pulverised fuel	230,000 lb. steam per hour each

The experience gained on land in the matter of burning powdered coal is not directly applicable to marine purposes, as the furnaces of land boilers can be made higher and longer than ship boilers; and as the flame produced from powdered coal may be 20ft., 30ft., or 40ft. long, or even more, there is not the same difficulty in making boilers to suit such flames as there is for ships. Mr. Peabody has produced a burner designed to make a short enough flame to burn in an ordinary sea-going marine boiler having cylindrical furnaces, and has fitted these burners to two boilers in the ss. "Mercer," which has twice crossed the Atlantic. Other burners have been proposed, but so far no experience is available of their use at sea. [An illustrated description of several of these burners is given in an Appendix A, which is not reproduced.]

It is claimed that the results of the plant on the "Mercer" are sufficiently satisfactory to justify the experiment, and that a saving of 10 per cent. over hand firing may be expected from the use of such plant. The boiler efficiency determined in the Philadelphia Navy Yard in a Scotch boiler using pulverised fuel in a Peabody burner was 70 to 77 per cent., and 79·6 to 83·8 per cent. in a Babcock boiler of marine type at the Bayonne plant.

It seems, therefore, that in order to give coal a chance to hold its own against oil the methods which have to be adopted in oil-fired boilers must be imitated. The coal must be pumped on board. Coal is already being handled pneumatically in this country at the rate of 50 tons per hour through a single pipe. A combination of such plants would coal any vessel. It must also be forced into the furnaces in a way similar to that in which oil is used. This was not done in the case of oil until a proper oil burner was developed, and was not worked successfully until time had shown what precautions are necessary to avoid undue risk and to ensure reliability. This development was largely done by the Admiralty for its own war purposes, but as no war purpose seems likely to emerge in the immediate future which may lead to the development of coal burning by the Admiralty, some other Government Department may possibly take this matter in hand. The Fuel Research Board may be mentioned in this connection.

To state the economic position at the present moment, taking account of actualities and possibilities, Table I. has been prepared, based on costs supplied by firms willing to build at the prices named and fuel consumptions actual in some cases, and in others deemed to be possible. The boiler arrangements for the high-pressure proposals are for 3600 S.H.P. turbines on continuous sea service, and are for three boilers abreast. It is quite practicable to produce the power with two boilers. The first cost of using two instead of three will be about £2000 less in the case of the boilers with mechanical stokers and £2500 in the case of the boilers fitted with pulverisers, and the final savings will be increased by £400 to £500 per year above the three-boiler arrangement.

In Appendix B [not reproduced], there is given a comparison of the space occupied by the machinery and bunkers of a vessel recently built, with another of the same dimensions showing what can be done with boilers of the Babcock and Wilcox and Yarrow types associated with turbine machinery. In the same space 20 per cent. more power can be installed with the H.P.T. system than with ordinary triples, and a gain of over 300 tons of space; or with the same space filled with coal, a gain of 40 per cent. of radius of action.

The figures in Table I. do not deal with costs of wages, food, fresh water, or machinery repairs. They only deal with the costs of machinery and fuel and the cost charges due to interest, depreciation, and insurance. They deal only with the differences in weight carrying due to machinery and fuel.

The subject of repairs is probably the one in which different types of machinery differ most. There is very little published information as to the upkeep costs of oil engines. The only case which has come under my notice is for two oil-engined ships which averaged 40,000 miles per year and cost each about £10,000 per year for maintenance and £2000 per year for lubricating oil. Other ships of the same size and power propelled by steam, which steamed 60,000 miles each year, had corresponding figures of £1350 for maintenance and £300 for lubricating oil. These figures are actual, but may not be usual. Perhaps someone who is familiar with the costs of maintenance of ships' machinery may be disposed to enlighten us as to these costs.

Unfortunately for the exact determination of the relative commercial efficiency of different systems of power production, the first costs of machinery are not fixed nor easily determinable. For instance, one builder's price for a triple-expansion set of ordinary machinery is about £32,000, and for an oil engine set of the same power £84,500. The corresponding figures from another builder are £40,000 and £75,000, and from a foreign builder as low a price as £61,200 for an oil engine. While the figures given in Table I. are fair average figures upon which the number of ships of the types suggested are likely to be built, it is thought that it may be interesting to give the result of calculations based on the other figures mentioned. Table II. shows these results.

TABLE I.—*Table Showing Savings in Running Costs of Various Types of Machinery of 3600 S.H.P. on Continuous Sea Service if they are Used Instead of the Ordinary Triple-expansion Engine and Low-pressure Cylindrical Boiler.*

Oil is taken at 80s. per ton.	1. Ordinary triple steam.	2. Ordinary triple superh'ted steam.	3. Quadruple superh'ted steam.	4. Turbine with superh'ted steam, cylindrical boilers.	5. Turbine with high pressure water-tube boilers, superh'ted steam.	6. Turbine with high-pressure water-tube boilers and mechanical stokers.	7. Turbine with high-pressure water-tube boilers and pulverisers.	8. Oil engines.
Boiler pressure, lb. per sq. in. ..	200	200	200	200	525	525	525	—
Temperature, steam, deg. Fah. ..	390	590	590	590	750	750	750	—
Cost of machinery	£36,000	£39,500	£46,000	£56,000	£62,000	£63,500	£68,000	£85,000
Consumption, tons per day	62	56	52½	44½	40½	38½	36½	17½
Pounds per S.H.P. per hour	1·6	1·45	1·36	1·15	1·05	1·00	0·95	0·42
Weight of machinery, tons	850	850	880	750	720	740	770	825
Difference in weight in tons carried due to difference in fuel carried for 200 days	Zero	1,200	1,900	3,500	4,300	4,700	5,100	8,900
Difference in weight in tons carried due to difference in weight of machinery for ten voyages per year	Zero	—	300	1,000	1,300	1,100	800	250
Difference in cargo earnings at £1 per ton per voyage for ten voyages per year..	Zero	£1,200	£1,600	£4,500	£5,600	£5,800	£5,800	£9,150
Savings in fuel costs in 200 days at £1 per day	Zero	£1,200	£1,900	£3,500	£4,300	£4,700	£5,100	−£1,600
Cargo, net earnings in excess of triple steam, Column 1	Zero	£2,400	£3,500	£8,000	£9,900	£10,500	£11,000	£7,550
Charges, 18½ per cent. of cost of machinery, in excess of triple steam, Column 1	Zero	£647	£1,850	£3,700	£4,810	£5,087	£5,920	£9,065
Net savings per year over triples ..	Zero	£1,753	£1,650	£4,300	£5,090	£5,413	£5,080	−£1,515

TABLE II.

Type	Triple steam.	Oil engine.	Oil engine.	Oil engine.	Oil engine.
Oil is taken at 80s. per ton.	£	£	£	£	£
(1) Cost of machinery	32,000	61,200	75,000	84,500	87,000
(2) Cargo earnings in excess of triples due to difference in weights of fuel and machinery	—	7,040	6,240	6,390	5,440
(3) Charges in excess of triple..	—	5,402	7,955	9,712	10,175
(4) Net savings per year—difference between (2) and (3) ..	—	1,638 More	1,715 Less	3,322 Less	4,735 Less

Confining our attention to the differences in savings between H.P. turbines and the oil engine, we have the figures given in Table III.

If we take the triples at £32,000, as per Table II., instead of £36,000 as in Table I., the savings of H.P.T. over triples will be:—

£4350 £4703 £4340

and the savings of the oil engines in Table II. over the triples being:—

+ £1638 − £1715 − £3322 − £4735

the differences between the H.P.T. and the oil engines will range from

£2702 to £9438

per annum in favour of the steam according as the price of the oil engine ranges from £61,200 to £87,000.

TABLE III.—*Annual Savings of H.P.T. Steam Over Oil.*

	H.P. turbines.		
	Coal-fired w.t. boilers.	Mechanical stokers.	Pulverisers
	£	£	£
Savings of H.P.T. over triple	5090	5413	5080
Excess over triple in oil engine	1515	1515	1515
Annual savings of H.P.T. over oil engine..	6605	6928	6595
Difference in other expenses (see p. 3)	350	350	350
Gain of steam H.P.T. over oil engine per year..	6255	6578	6245

It is suggested that the foregoing give some of the figures relevant to the present position of the fuel question, and it is hoped that they will afford scope for discussion, not only in this Institution, but wherever shipowners and naval architects have the desire to produce the most economical ships.

I have to thank my colleague, Engineer Rear-Admiral W. Scott Hill, for his assistance in preparing this paper.

Logical Principles of Classificatio n

By S. C. BRADFORD, D.Sc., Science Library, South Kensington, S.W.

IN a previous article the author described the Subject-Matter Index that has been organised in the Science Library, South Kensington, as a means of supplying the information to research workers and engineers, the lack of which in the past has been an ever-present and increasing hindrance to progress. Although the importance of ascertaining what previous work has been done on a given subject of investigation is recognised generally, the immensity of the store of recorded information, at present locked out of reach in the printed volumes on the library shelves, is realised by few. Nor do most of those who strive patiently and laboriously to extend the boundaries of human knowledge, or to provide better tools or new sources of power for the use of mankind, foresee more than dimly that in many cases the hard-won results of their work are likely to do no more than add to the musty archives of forgotten achievements.

It is this appalling waste of the fruits of the highest kind of human activity that the Science Library is endeavouring to remedy. The task might well seem impossible to accomplish, for the printed record of scientific and technical information is growing at the rate of from twelve to fifteen thousand volumes a year. Certainly it would be hopeless were the magnitude of the undertaking not fully realised. One of the reasons for the lack of a comprehensive index to recorded information in the past has been that the quantity of material to be indexed has been altogether underestimated, and the scale on which most of the existing indexes have been conceived has been Lilliputian. But when the extent of the enterprise is visualised another difficulty arises—that the work is vastly greater than can be undertaken by a single institution.

The Science Library is attempting to solve the problem by adopting a classification that is sufficiently flexible and extensive to comprehend all knowledge, and by recommending that all bibliographical undertakings should adopt the same classification; for it is only by the adoption of a single system that the present chaos of divided effort can be reduced to order and all may work together for the common good.

The question will now be asked, "Why has the Brussels Classification been adopted? This classification may be very good for most subjects, but," the inquirer may say, "for the one in which I am most interested, it is inadequate." A complete reply to this question would need a course of lectures and practical instruction, for there is a technique of classification, and it is impossible for anyone to select, or prepare, a satisfactory scheme for any science without an expert theoretical and practical knowledge of both the subject of classification and the subject to be classified. As this combined knowledge is rare, the number of faulty classifications is multifarious.

Fortunately, however, the general principles of classification are simple, and a short outline of the subject can be given.

The answer to the second part of the question asked may first be stated, and is that in all probability the inquirer does not understand the Brussels Classification, and, in any case, that the logical order and completeness of a section of a classification is a mere detail as compared with the principles on which the classification is based. It may be easy to add to, or rearrange, the subject-divisions of a classification, if these are really insufficient, but, unless the whole is drawn up on sound principles, the classification must be unsatisfactory.

In considering the principles of Classification, we must recognise that what we classify are Things, and that Things have Attributes. The act of Classification is a mental process, in which we imagine that we have picked out all things that possess a certain Attribute or set of Attributes, and put them together in a group by themselves. Such a group is called a class. But there are very many attributes that are common to a variety of things, and if we attempt to make a Classification by allotting a separate class to every possible attribute of every kind of thing, the size of the Classification would become enormous. It would indeed contain the extent of human knowledge, and include besides classes that are now imaginary but that may become real in the future.

When the novice in the art of classification attempts to tabulate all the classes of a given subject, he sets himself a task of such an order of magnitude. And realising, subconsciously or otherwise, the impossibility of making the scheme complete, he is obliged to be content with a selection of what he considers to be the most necessary headings. Naturally, almost every selection is different, and confusion inevitably results.

Now, although much has been written on the application of logic to the arrangement of the classes in such an elementary scheme, it was left to the lawyers Messieurs Otlet and La Fontaine, in 1899, to apply the laws of logic to the principles of classification itself, and the result was the Brussels Classification, which is therefore unlike any other scheme, being at the same time more simple and almost infinitely more comprehensive.

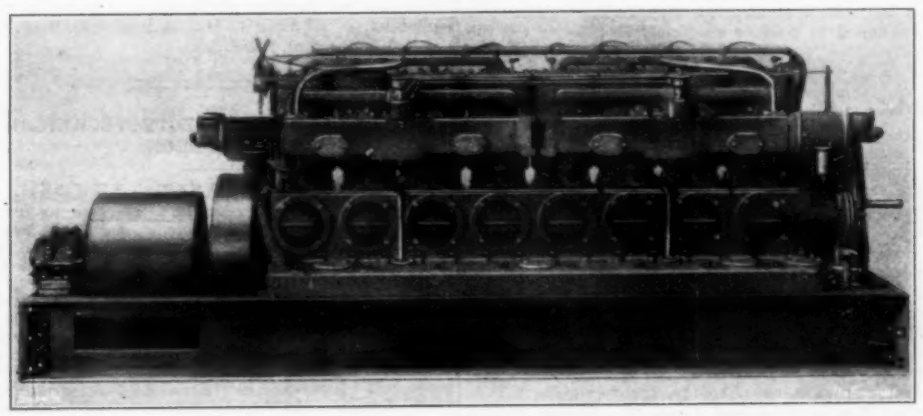
Let us suppose that we represent by x_1 a thing defined by a single attribute or by a restricted set of attributes—let us say, the substance sulphuric acid. Now, if we are classifying literature on sulphuric acid, we shall have to deal with many forms of books and papers, in which this substance is treated from many different points of view. The literature of sulphuric acid is, in fact, a collection of things, any one of which may be represented by $x_1\ m_1\ n_1\ p_1$ where m_1, n_1, p_1, &c., indicate various attributes of the literature or of the substance sulphuric acid. For instance, there will be papers on theoretical or experimental studies relating to the manufacturing process, at the start, while in use, or after modification; papers from the point of view of realisation of the manufacture, such as gathering materials, special operations, raw materials, accessory products, machines employed, fixed machinery, engines, machine tools, implements, results obtained, by-products, fittings and apparatus; papers from the economic point of view, such as cost of materials, labour, selling price; from the point of view of premises, sites and *personnel* of various kinds. These and other general points of view are common to the various branches of the sulphuric acid industry, as well as to a vast number of specific subject divisions. Again, it will be necessary in many cases to classify bibliographical material according to place, time or language, or, it may be, according to the form of the work. Thus, sulphuric acid manufacture may need to be treated from the point of view of country or period, or it may be desired to distinguish between large treatises, manuals, books of tables, popular descriptions, collected papers or historical studies.

It is obvious therefore that a classification, in which a separate class is allotted to each aspect of every conceivable subject division, would occupy many hundreds of volumes. On the other hand, by classifying separately, in a number of auxiliary tables, as many as possible of the attributes m, n, p, that are common to a number of things, the size of the main classification of things, represented by x, is reduced to its smallest limit, and each class of the main classification can be subdivided, as required, by the use of the auxiliary tables. This is the principle of the Brussels Classification, which is thus able to represent in a single volume almost every conceivable set of attributes in the universe.

There is no other classification which has been reduced to its simplest terms in this way, or which is capable of indexing the great variety and quantity of literature, in which the multifarious activities of mankind are recorded. There is therefore no other classification that could be adopted with success for an undertaking of this magnitude. In a later article the details of the system will be described.

A Stationary Oil Engine for High Altitudes.

WE show in the accompanying illustration a stationary oil engine which has recently been constructed for transportation to, and for working at high altitudes by the Parsons Oil Engine Company, Ltd., of Southampton. It is an eight-cylinder unit of the Parsons standard type with bores of 6¼in. and a stroke of 8in., which, when running at 750 r.p.m., is designed to develop 110 to 140 B.H.P. The order was placed by Messrs. Hooper, Speake and Co., mining engineers, of London, who acted in an advisory capacity for the Southern Finance Company. The engine in question is to be used at a new mine in Peru, which is being opened up in a locality some 14,500ft. above sea level. As there is no access to the mine site either by road or rail, arrangements had to be made for mule transport with its inherent difficulties and limitations. While requiring a thoroughly robust commercial engine for belt driving, it was stipulated that no individual part of the unit should weigh more than 600 lb. In order to meet this special condition the engine builders decided to construct the engine crank chamber and bed-plate in aluminium alloy. In this metal the lower part of the crank case—which is the heaviest part of the engine—weighed slightly under 5 cwt. From our illustration it will be seen that the crank case bearers rest on an underframe built up of deep section steel girders. They are bolted together by angles at the corners, and the longitudinal members are extended to embrace the driving pulley and the outboard bearing. Steady pins are fitted to this underframe so that it can easily be assembled, and a slot is cut through the web to allow the underpart of the belt to pass through it. With the exception of the steel underframe and the lower part of the engine crank case all other parts of the engine can, we are informed, be carried by a single mule. Prior to shipment the engine was tested at the makers' works under conditions similar to those under which it will operate on site, a suitable allowance being made for the loss of power which will be occasioned by the engine working in a rarified atmosphere.



8-CYLINDER OIL ENGINE DESIGNED FOR USE AT HIGH ALTITUDES

The Institution of Civil Engineers.

CENTENARY OF ITS ROYAL CHARTER.

BY way of marking the centenary of the granting of its Royal Charter, the Institution of Civil Engineers is proposing to hold an engineering conference. The plans are now taking definite shape and the following general outline of the contemplated proceedings has been made public.

On Sunday, June 3rd, at three o clock, the President and Council will attend the service in Westminster Abbey, where certain seats will be allotted for delegates and members of the Institution. The centenary celebrations will open on June 4th with an address by the President, which will be followed by a formal reception of the delegates, and in the afternoon of the same day the James Forrest Lecture for 1928 will be delivered by Sir Alfred Ewing, who will deal with the subject "A Century of Inventions.

On the following morning the conference will be opened with an address by the President, and meetings for the discussion of engineering subjects will be held during the morning. The afternoon will be devoted to visits to engineering works in or near London, and the Institution conversazione will take place in the evening.

The next day will be occupied with whole-day visits to engineering works at a distance from London, and it is hoped that the limits placed upon the numbers of the parties will be such that every member attending the conference will have the opportunity of taking part in one of these visits.

On the following morning the meetings of the conference will be resumed, and in the afternoon further visits to works in or near London will take place. In the evening a banquet will be given to the delegates.

Arrangements have been made for the following subjects to be introduced for discussion at the conference:—Recent Developments in Concrete and Cement for Engineering Structures; Steel for Shipbuilding; The Properties of Materials for Use at High Temperatures, with special reference to Boilers for Superheated Steam; Developments in the Use of Materials in Railway Engineering; Railway Design and Maintenance as Affected by the Application of Electricity; The Dimensions of Harbour and Dock Approaches; Harbour Breakwaters; Tidal Power and Turbines Suitable for its Utilisation; Progress in Hydro-electric Installations, including Intakes, Leats, Tunnels, Dams, Headraces, Pipe Lines and Tailraces; Road Vehicles in Relation to Roads; Modern Road and Bridge Construction; The Filtration and Treatment of Water for Domestic Purposes; Floods, with special reference to Waste Weir Capacity; The Advantages of Different Types of Sewage Tanks; Sewerage, with special relation to Run-off; Utilisation of Solid and Liquid Fuels; Coke Oven, Town and Producer Gas; Modern Trend in Boiler Practice; The General Trend of Modern Development in Steam Turbine Practice; Prospective Development in the Generation of Electricity and its Influence on the Design of Future Power Stations; Light High-speed Internal Combustion Engines; Heavy Internal Combustion Engines; The Generation and Utilisation of High-pressure Superheated Steam for Marine Propulsion; Progress in the Adoption of the Internal Combustion Engine for Marine Purposes; Latest Types of Steam and Internal Combustion Locomotives; Electric Transmission of Power as Applied to Large Areas; Domestic Lighting and Heating and its Influence on Load Factor of Supply; Waterless Gasholders; Problems Involved in Mining at Great Depths; and The Metallurgy of Complex Lead-zinc-copper Ores.

A programme, to be issued in May, will contain detailed information as to the notes and their introducers, the form in which advance proofs will be issued, and the arrangements for the various discussions.

A report of the proceedings of the conference will be prepared and published by the Institution in two parts, which will be available to members on payment of a charge covering the cost of presswork, paper, and postage.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LOCOMOTIVE DESIGN AND ORDERS WITHIN THE EMPIRE.

Sir,—The news appearing in The Engineer during December last regarding further large orders for locomotives for South Africa being placed in America and Germany makes very unsatisfactory reading, as exemplifying the wretched conditions reigning in the British locomotive-building industry during these later days. The writer does not consider this a matter of recent growth, nor solely a question of present relative costs of construction in England compared with the other countries named. He does not propose to treat directly of the question of costs, although the technical aspect about which he proposes to offer certain remarks naturally has very considerable bearing on the matter.

It is axiomatic that a firm which has already built some of a class of locomotive to be supplied has a very great advantage over its competitors—and particularly when important departures in design are included. From the technical point of view it is necessary to go back two years or so, at which time locomotive-building firms of the U.S.A., having made a study both of the traffic necessities and physical conditions to be met on certain of the Indian, South African and other railways, got out designs to meet those conditions. These were then presented to the respective railway authorities with a statement or guarantee of what the locomotives would accomplish, naturally it being understood that when the locomotives had fulfilled expectations there would be further orders.

The various locomotives (there were about twenty-four of these "pattern" engines of some eight different classes) on the different lines having fulfilled expectations as to load hauling and other traffic requirements—as was obvious to a locomotive engineer they were capable of doing—the designs are being perpetuated, and again naturally enough the original builders and country of origin are in a favourable position.

It is to be noted that very many of the latest (modern) locomotives for India, South Africa, South Australia, &c., follow in general design the pattern locomotives referred to, but naturally having the British greater care and attention to detail both in their design and construction, they should give much better results as to maintenance and repairs and as good results in regard to traffic as the pattern engines. Why, however, were such locomotives not designed and put into service before? At the time referred to, many fine modern classes of engines were in service or designed for the railways of most of the lesser Colonies without waiting for a lead from outside.

The point which the writer would like cleared up is: Why were no locomotives designed and put into service to meet the traffic conditions which had developed in the countries referred to in the last ten years or so, so allowing outsiders to present fully-matured designs. If we in England had allowed locomotive practice to get so behind the times in respect to the home railways as to allow of a similar situation, it would have been considered a grave reflection on our locomotive engineers.

Is the cause lack of initiation on the part of the responsible locomotive engineers on the spot, or is it lack of attention to their representations by the higher authorities? Even latterly locomotives for metre gauge and similar lines have been constructed with boilers insufficiently proportioned to produce effectively in practice the full rated tractive force of the engines and having fire-boxes and grates quite unsuitable for burning poor coal effectively—or indeed any coal to full advantage.

February 21st. Midloco.

RAILWAYS AND WIND-TUNNELS.

Sir,—Although up to the present there has been no indication that the railway companies regard the aerodynamical work contained in my book, "The Resistance of Express Trains," as being worthy of consideration, the article recently published in The Engineer by Mr. F. C. Johansen, shows that it has attracted attention and met with approval at the National Physical Laboratory.

For reasons set out in the article, a serious set of experiments on the air resistance of a train of a quantative nature presents problems which, though not by any means impossible of solution, in the light of the experience of the N. P. L. derived from aeronautical work, nevertheless involve some complications and considerable expense. The chief difficulty is to represent the ground, which, for investigating conditions in a calm, should be at rest relatively to the air-stream.

But there are numerous investigations that could be made very simply and cheaply, and without the delay which would be required to design and construct any of the apparatus proposed by Mr. Johansen.

First, with merely a flat platform under the model, comparative tests could easily be made of different forms of the whole or any portion of an engine or carriage, which would enable the best one to be discovered, and adopted in practice. It is to be feared, however, that this possibility will not make much of an appeal in responsible quarters, because it is only necessary to look at any of our express engines to realise that up to the present any shape is thought good enough. But now comes something which is probably more likely to attract attention.

The air pressure on the front of an engine travelling at a high speed is so tremendous that it seems quite possible that if the correct form could only be arrived at—which could only be done by experiment—two highly desirable results could be attained, namely, the augmentation of the smoke-box vacuum, allowing an auxiliary exhaust outlet to be brought into use to relieve the back pressure, and the carrying of the steam up above the cab windows. It would be easy, for instance, to try the effect of a chimney like that suggested in my book, with and without an "air-ship" front to the smoke-box, and measure the vacuum produced, as compared with the ordinary form of chimney. Also, smoke could be pumped into the model in order to observe the effect of devices like the plates which have recently been fitted to the express engines on the Southern Railway. The effect of these plates, by the way, is probably rather spoilt by the retention of the rim round the top of the chimney.

Many investigations of this kind could be carried out quite easily, so long as only comparative results are aimed at. Others that come to one's mind are the effect of "fairing" the front corners of a Belpaire fire-box, and of abolishing "eaves" on the front of the cab, Worsdell splashers, &c. Benefits which might accrue from modifications of this kind would, of course, be so small that they would be impossible to discover in practice, and could only be detected by the delicate methods of the N. P. L. At the same time, it must be remembered that they would be cumulative, and would all tend in the direction of economy of coal.

The scientific research of the whole subject is, of course, one which ought to be undertaken properly, but admittedly presents some serious difficulties, and would require a considerable amount of time and money, whereas the tests suggested above would be easy and inexpensive, and hold out an almost certain promise of tangible practical results. C. F. Dendy Marshall.

March 19th.

A COMPRESSED AIR METER.

Sir,—In Mr. Laschinger's letter in your issue of March 16th he states that the shaped scoop of the Kent-Hodgson gate meter is not designed on the principle of the meter described in his paper, and that it was to effect an improvement that his meter was evolved.

I have already pointed out that meters having equally spaced flow scales and fitted with the shaped scoop and the slotted plate—which are the distinguishing features of the meters which Mr. Laschinger describes as new—were sent out to Johannesburg by my firm in 1912 and 1914 respectively. These meters incidentally, by enabling the efficiency of the rock drills to be tested before they were sent underground, have saved the gold mining industry on the Rand about £120,000 per annum. They are, of course, later than the twenty large Kent-Hodgson gate meters which measure practically the whole of the air taken by the gold mining companies, to which Mr. Laschinger refers in his letter.

There is nothing new in the meter which Mr. Laschinger has described, as suitable shaping of the scoop has always been a feature of the Kent gate meters. Thus, in a paper on metering which was published in the *Journal* of the South African Institution of Engineers in 1911 and in the discussion of which Mr. Laschinger took part, I wrote: "By suitably shaping the cavity in which the door swings it is quite possible to measure down to one-hundredth of the full flow."

I note that Mr. Laschinger agrees that, in spite of his elaborate—and as I have suggested, futile theory—for calculating out the shape of the slot, each meter has to be calibrated. John L. Hodgson, M. Inst. Mech. E.

Leighton Buzzard, March 28th.

INTERNATIONAL ELECTROTECHNICAL COMMISSION.

INTERNATIONAL TECHNICAL MEETINGS.

International congresses and meetings to discuss technical subjects are on the increase, and so also are the possibilities of overlapping of effort. Whilst these facts are quite well recognised, until recently apparently no concerted action has been taken to attempt to minimise, if not to prevent, this state of affairs. On the occasion, however, of the meeting in Italy in September, 1927, of the International Electrotechnical Commission, the opportunity was taken to convene an unofficial meeting of representatives of several international organisations which happened to be holding meetings in Italy about that time. Signor Guido Semenza, the then President of the I.E.C., was in the chair, and seven international technical organisations were represented. The idea of contact with each other through some central committee was well received, and the I.E.C. which had initiated the movement was invited to act as convener for such an unofficial committee.

In January of this year a first meeting of the unofficial "Comite d'Entente," as it was suggested it should be called, was held in London at the offices of the I.E.C., when representatives were present from the International Illumination Commission, World Power Conference, International Consultative Committee on Long-distance Telephony, International Union of Producers and Distributors of Electrical Energy, International Standards Association (in process of formation), International Electrotechnical Commission. Professor Clarence Feldmann, the new President of the I.E.C., was in the chair, and an interesting exchange of information took place regarding dates of future meetings and in one or two cases of the preliminary programmes. It was felt that if information of such a character regarding dates and programmes could be exchanged at infrequent intervals, say, once annually, it would be bound to lead gradually to most helpful co-operation and be of advantage to the delegates attending the many international meetings, as well as probably enhance the value and usefulness of the meetings themselves.

The question of the co-operation between international organisations by joint international committees as well as by observers was also touched upon. Finally it was decided to keep the unofficial committee in being with the I.E.C. as convener and to call another meeting a year hence, by which time the various organisations represented would have had time to give their official decision, which in most cases, it is anticipated, will be favourable, regarding the pernanent establishment of such a committee. It is also hoped that other international organisations in the technical field will be interested in this co-operative idea, which, while leaving each organisation entirely free, yet provides a kind of clearing house through which information may be exchanged and administrative matters discussed in a free and friendly manner.

LAUNCHES AND TRIAL TRIPS.

British Honour, motor oil tank vessel; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the British Tanker Company, Ltd.; to carry 10,000 tons deadweight. Engines, single-screw Sulzer; launch, March 7th.

Tia Juana, shallow-draught oil tanker; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., for the Lago Shipping Company; dimensions, 315ft. by 50ft.; 2360 gross tonnage. Engines, twin-screw triple-expansion, pressure 180 lb. per square inch; launch, March 8th.

Troisdoc, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steam Ships, Ltd., Fort William, Ontario, Canada; dimensions, 253ft. Engines, inverted marine type with three cranks; constructed by Swan, Hunter and Wigham Richardson, Ltd.; launch, March 9th.

Beaverbrae, cargo steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Canadian Pacific Railway Company; dimensions, 512ft. by 61ft. 6in. Engines, two sets of single reduction Parsons' type geared turbines, pressure 250 lb. per square inch; constructed by Parsons Marine Steam Turbine Company; a speed of over 15 knots was attained on trial trip, March 9th and 10th.

Thedeus, steamship; built by the De Maas Shipbuilding Company, Slikkerveer, Holland; dimensions, 299ft. 11in. by 45ft. 11in. by 17ft.; 1340 tons deadweight. Engines, triple-expansion; constructed by Messrs. Fijenoord Company; a speed of 12¼ knots was attained on trial trip, March 12th, 1928.

Bee, twin-screw motor vessel; built by James Pollock, Sons and Co., Ltd., London and Faversham; to the order of Shepard Brothers, Ltd., Newport, Isle of Wight; dimensions, 79ft. 6in. by 16ft. 6in. by 6ft. 9in.; to carry 60 tons. Engines, two 40 B.H.P. Bolinder direct-reversible heavy oil engines; trial trip recently.

Elsa, motor-driven tanker; built by Barclay Curle and Co., Ltd.; to the order of Harry Borthen and Co., Norway; dimensions, 400ft. by 52ft. 6in. by 30ft. 6in.; to carry oil in bulk. Engines, Barclay Curle-Doxford opposed-piston patented airless injection oil engine type of 2000 B.H.P.; constructed by Barclay Curle and Co., Ltd; launch, March 14th, 1928.

King Lud, motor cargo vessel; built by Harland and Wolff, Ltd.; to the order of the King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; gross tonnage 5180. Engines, one Harland-B. & W. six-cylinder four-cycle single-acting Diesel engine; constructed by Harland and Wolff, Ltd.; handed over to owners, March 15th, 1928.

Deido, motor vessel; built by Ardrossan Dockyard, Ltd., to the order of the African Steamship Company; dimensions, 355ft. by 49ft. by 24ft. 8in.; gross tons 3878, register tons 2122. Engines, one single-acting Diesel engine, six cylinder, 740 mm. diameter by 1500 mm., developing 1800 B.H.P.; constructed by J. G. Kincaid and Co., Ltd., Greenock; trial trip, March 15th and 16th.

Punta Benitez, shallow-draught oil tanker; built by Harland and Wolff, Ltd.; to the order of the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft.; gross tonnage 2360. Engines, twin-screw triple-expansion type, developing 1100 H.P., pressure 180 lb. per square inch; trial trip, March 16th, 1928.

Catatumba, twin-screw oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of Venezuela Gulf Oil Company. Engines, twin-screw, triple-expansion; constructed by Palmer's Shipbuilding and Iron Company, Ltd.; launch, March 20th.

Deal, twin-screw steamer; built by D. and W. Henderson and Co., Ltd., to the order of the Southern Railway; dimensions, 230ft. by 33ft. 8in. by 15ft.; to carry mails and cargo, 680 tons gross. Engines, two sets triple-expansion, 15in., 25in. and 41in. by 24in. stroke, pressure 200 lb. per square inch; constructed by D. and W. Henderson and Co., Ltd.; trial trip, March 20th.

Cartierdoc, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steam Ships, Ltd., Fort William, Ontario; dimensions, 253ft. long; to carry cargo. Engines, inverted marine type; constructed by Swan, Hunter and Wigham Richardson, Ltd.; trial trip, March 22nd.

Gretafield, single-screw oil tanker; built by Cammell Laird and Co., Ltd., to the order of Hunting and Son, of Newcastle-on-Tyne; dimensions, 498ft. by 67ft. 6in. by 37ft.; deadweight, 14,400 tons. Engines, single-screw balanced quadruple-expansion, 28½in. by 41in., 59in. and 85in. diameter by 57in. stroke, pressure 220 lb. per square inch; launch, March 22nd.

King Arthur, motor cargo vessel; built by Harland and Wolff, Ltd., to the order of King Line, Ltd.; dimensions, 400ft. by 54ft. 6in. by 34ft. 8in.; 5180 gross tonnage. Engines, one Harland-B. and W. six-cylinder, four-cycle, single-acting Diesel engine; constructed by Harland and Wolff, Ltd.; launch, March 22nd.

Lavaldoc, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steam Ships, Ltd., Fort William, Ontario; dimensions, 253ft. long; to carry cargo; Engines, inverted marine type; constructed by Swan, Hunter and Wigham Richardson, Ltd.; trial trip, March 22nd.

Pacific Exporter, twin-screw motor vessel; built by Blythswood Shipbuilding Company, Ltd., to the order of Gulf Line, Ltd.; dimensions, 450ft. by 60ft. by 42ft. Engines, twin sets of single-acting Diesel engines (Burmeister and Wain-Harland and Wolff system) of over 4000 B.H.P.; constructed by John G. Kincaid and Co., Ltd., Greenock; launch, March 22nd.

Novadoc, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steam Ships, Ltd., Fort William, Ontario; dimensions, 253ft. long. Engines, inverted marine type; constructed by Swan, Hunter and Wigham Richardson, Ltd.; launch, March 23rd.

Hooiberg, shallow-draught oil tanker; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co. for the Lago Shipping Company; dimensions, 315ft. by 50ft. Engines, twin-screw triple-expansion, pressure 180 lb. per square inch; constructed by Harland and Wolff, Ltd.; launch, March 27th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

A FALTERING tone pervades the iron and steel industries of the Midlands and Staffordshire, and what progress has been made in some branches is of a fluctuating character. There is no appreciable change in the volume of demand from week to week, and buying continues of a hand-to-mouth nature. Values, too, change but little, and an apathetic spirit is prevalent. A real and lasting improvement in activity at the heavy engineering works in the Midlands is required before marked animation in the Birmingham iron and steel market can be expected. Consumptive requirements are so small that profitable production of raw materials is almost impossible, and, even so, iron and steel masters are at their wits' end to know how to keep the plant running. A resumption of continental competition in the steel department is signified by the reduction this week of shippers' quotations and the shortening of delivery dates.

Steel.

Steel demand is practically unaltered, and values are quotably unchanged. This week there has been a slightly improved call for structural material, and the shipyards are taking more material, but the consumption of engineering branches as a whole is expanding only slowly. Unfortunately, a good deal of continental steel continues to arrive in the district, but buyers who have been holding off during the past month or two show no disposition to change their attitude. Antwerp shippers are naming earlier dates for delivery, and the recent advance in prices is not being so rigidly enforced. Indeed, there are some shippers who this week have offered supplies at lower rates. On 'Change in Birmingham to-day 2in. billets were offered at £5 11s., and in at least one case £5 10s., while small bars were obtainable at £6 7s. 6d. British billet makers for the most part wanted £6 per ton, but there were still Welsh billets to be had at £5 15s., though the mills, on account of recent commitments, were not so anxious for business as of late. The new price relationship which had come about prior to this week's relapse in continental quotations, had put more business in the hands of district strip mills, and they are now comparatively active. Staffordshire hoops are maintained at £10 10s. at works, while small steel bars are named from £7 7s. 6d. to £7 17s. 6d

Pig Iron.

The pig iron situation in the Midlands in regard to supplies is easy, and furnacemen are kept on the stretch endeavouring to prevent a serious break in current values, pending the revival of demand which they are confident is at hand. The continued absence of any real stimulus from the building industry tends to loosen confidence in the price position. There is no appreciable difference so far as actual transactions are concerned. Consumers, however, hope sooner or later to profit by the weakness of demand. Derbyshire quotations are maintained at £3 4s. to £3 4s. 6d. for foundry and £2 19s. for forge. Northamptonshire smelters adhere to £3 for No. 3 foundry as the basis of their bargaining, but it is said actual business can be put through at slightly less. Forge is named £2 14s. at furnaces. One or two exceptionally good sales of the latter material have recently been reported, but there is no general improvement in demand.

Finished Iron.

The Staffordshire iron trade has developed no marked feature of interest during the week. The marked bar department is better off for business than the other finishing branches, and the £12 10s. basis is obtained without difficulty. There is no pressure on any of the mills. The Lancashire and Staffordshire makers of Crown iron continue to quote in the neighbourhood of £10, but for iron from other districts sales can be made at a much lower figure, £9 5s. and £9 7s. 6d. being often quoted. Nut and bolt and fencing iron quotations remain at £9 per ton, but little business is passing. Wrought iron gas tube strip commands £11 10s. Re-rollers are fairly well engaged, but competition is severe.

Galvanised Sheets.

Galvanised corrugated sheets, after receding somewhat under pressure to sell, had recovered their firmness and are now quoted £13 5s. and £13 7s. 6d. for 24 gauge. A few mills well booked are asking a little above the latter figure. Deliveries are now obtainable within three or four weeks. Overseas business is fluctuating, but there are good tonnages on order. There has been slightly less activity in this department, however, this week.

Electrical Industry's Future.

The immense possibilities of development in the electrical industry in the future and the progress made in recent times were remarked upon by speakers at the annual dinner of the Birmingham Electric Club on the 24th inst. Mr. S. T. Allen, chief engineer of the West Midlands Joint Electricity Authority, expressed the opinion that the industry was fast becoming one of the most important in the country. It embraced, he said, enormous fields of activity, and its operations affected and entered into practically every phase of our modern life. Speaking of the importance of increasing the number of units sold per head of the population, he said that there was need for a comprehensive commercial policy. Referring to the Central England scheme of the Electricity Commissioners, Mr. Allen advised them to support the Central Board in its difficult operations in this district and to confine their criticism to constructive proposals. Major-General Sir Philip Nash said that it had always been a marvel to him that the industry was so successful when he looked back on the legislative restrictions that had surrounded it for many years. He hoped the industry had passed through the period of what was known as parochial consideration. There had been considerable progress on the manufacturing side of the industry in the last few years, and it had been achieved by serious concentration, research and development. Of the total primary power installed in this country, 48 per cent. was electrical; in Germany the percentage was 60; and in the United States 73. In the United States there were 16,000,000 houses wired for electricity, or 60 per cent. of the total number of houses. Of the 8,500,000 homes in Great Britain, about 60 per cent. were within ready access of electric cables, and yet, of the total number of homes, only 17½ per cent. were wired. There was an immense future before the industry in this country, and he thought it was a duty to build up the biggest industry Great Britain had ever seen.

Expression of Views.

Several matters of interest to Midland industrialists were touched upon by Mr. G. N. Guest, chairman of the Birmingham Chamber of Commerce at the annual general meeting of that body. He qualified his statement that there was no doubt the trade of the last quarter of last year showed a considerable improvement on what had gone before, by admitting that it was only good in patches. The old staple trades—cotton, iron and steel and coal—were, he said, in a very bad condition, so that by no stretch of the imagination could it be said the trade of the country was good. Still, there were several good things about the trade of last year. The number of trades disputes had been fewer, the total number affected being 89,600 men as against 2,724,000 in the preceding year, the days lost being 1,180,000, as compared with 162,230,000. Referring to the Rating and Machinery Bill of last year, he expressed the view that they would find it would not do them as much good as they thought. With regard to safeguarding, he found that out of forty-eight applications, only twenty had been referred to the Committee and only seven granted, which was not saying much for the Act. He understood, however, the Government in its next election programme would make proposals which, if agreed to, would give a better chance of getting safeguarding than in the past.

Industrial Peace.

Considerable satisfaction has this week been expressed in industrial circles hereabouts at the progress being made in the cause of industrial peace. It is considered that the Mond Conference upon ways and means of maintaining industrial peace made a marked advance, and that a decided step forward has been taken. Everyone wishes well to the endeavours being made by representative employers and employees towards such a laudable object.

Canal Bridges and Engineering.

The iron and steel and engineering industries of this district will, it is thought, benefit considerably as a result of the allocation of £250,000 towards the reconstruction of weak railway and canal bridges, and the construction of bridges to replace level crossings by the Government. It is stated that the railway companies, who are among the principal owners of canals, are prepared to make a larger money contribution than was originally contemplated towards removing the *impasse* with regard to inadequate canal bridges, many of which exist in this district. Some of the local authorities concerned are unwilling to assume any pecuniary responsibility, but it is hoped that the difficulties may be smoothed out, since trade generally stands to gain by an amicable settlement which will result in improved transport facilities at the works and occasion the use of considerable quantities of engineering material.

Coventry Engineering.

Coventry's premier industry—automobile engineering—though gradually improving, is not as brisk as it should be at this time of the year. A few favoured firms are well placed for orders, but the "boom" conditions reported in some of the papers are mythical. To talk in terms of a boom when unemployment in the motor manufacturing centre is higher for the time of year than it has been since 1923, is manifestly misleading and calculated to do more harm than good.

Tubes.

The tube trade in the Black Country is decidedly active. It is apparently one of the busiest departments of industry in this area, and were it not for keen external competition, the position would give ground for much satisfaction. Germany has of late had a share in the business given out, and is now sending in large quantities of finished tubes, in some cases, it is stated, to the order of the tube works themselves, who find it more profitable to factor foreign tubes than make them. Considerable tonnages of both iron and steel strip are, however, being worked up in this district, and prospects are considered good.

Unemployment.

The improvement in the unemployment position in the Midlands is maintained. The latest returns show that 128,685 persons are unemployed, as compared with 134,738 a week ago, a decrease of 6043. This follows decreases of 456 and 4326 in previous weekly returns. In the Birmingham area, the total of unemployed has fallen on the week from 26,272 to 24,571. At Coventry, unfortunately, there was a slight increase, viz., from 3029 to 3193, which would go to show that the motor engineering industry is not absorbing the labour it customarily does at this season of the year. Decreases are noted in Cradley Heath, Derby, Dudley, Leamington and Warwick, Nottingham, Oldbury, Peterborough, Redditch, Smethwick, Stoke-on-Trent, Stourbridge and Brierley Hill, Walsall, Wednesbury, West Bromwich, and Worcester.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

City's Electricity Estimates.

AN expenditure on capital account of about £620,000 during the coming year is budgetted for by the Manchester Corporation Electricity Committee. In accordance with the policy of the Manchester City Council and its Electricity Committee of furnishing as large a measure as possible of public utility, the estimated net surplus on next year's working, after allowing for all operation and management expenses and capital charges, will only amount to £52,000. Of the sum of £620,000 which the Committee expects to spend on capital account, a large proportion will be in connection with the work of completing the new Barton Station of the Manchester Corporation, the remaining expenditure being on extensions to the transmission and distribution systems and on meters, cookers and domestic appliances. In the opinion of the Committee, this capital expenditure is essential in order that the constantly growing demand for current may be adequately catered for.

Another Joint Electricity Board Scheme.

The Altrincham (Cheshire) Urban District Council, at a special meeting on Monday of this week, considered a proposal for joint action on the part of various local authorities in the area with a view to the purchase of the Altrincham Electricity Supply Company, Ltd., and the formation of a joint board representing the public bodies concerned. It was decided to make application to the Electricity Commissioners for a special order. The local authorities are the Urban District Councils of Altrincham, Ashton-on-Mersey, Bowdon and Hale, and the Rural District Council of Bucklow, the area of supply including also the parishes of Ashley, Dunham Massey, Timperley, Ringway, Baguley, Northenden, and Northern Etchells.

Steam Users' Association.

The annual report of the Manchester Steam Users' Association, which was presented at the annual meeting of that body held here on Tuesday, states that during the past year 26,768 examinations of boilers were carried out, and that the Association is able to report that no preventable explosion occurred of any boiler which carried its guarantee and certificate of safety. Mr. C. E. Stromeyer, who for over thirty years has occupied the position of chief engineer to the Association, retires at the end of the present month. His successor is Mr. Telford Petrie, D.Sc., who, since the war, has been making a special study at the Manchester College of Technology of boilers and heat engines.

Orders for Tramcar Equipment.

The Manchester Corporation Tramways Committee this week has accepted tenders for tramcar equipment, including motors, controllers and trucks, to the value of £12,000. The work will be carried out by the British Thomson-Houston Company, Ltd., Rugby; the General Electric Company, Ltd., London; and the Brush Electrical Engineering Company, Ltd., Loughborough.

Bigger Profits for Locomotive Builders.

Much more favourable results are shown in the annual report for the year ended last December of Beyer, Peacock and Co., Ltd., locomotive builders and engineers, of Gorton, Manchester. In the early part of the year, it is pointed out, the company's business continued to be adversely affected by the abnormal circumstances consequent upon the coal stoppage of the previous year, and it was not until March that normal activity was resumed. The fact that the trading profit increased from £33,576 in 1925 and £35,613 in 1926 to £59,141 in the year under review is, therefore, a reflection of the improved conditions. For the first time since 1922, when a distribution of 5 per cent. was made, the ordinary shareholders are receiving a dividend this time of 2½ per cent.

Mersey Reclamation Scheme.

A scheme for the reclamation of a portion of the river Mersey and the construction of a promenade at Otterspool, at the south end of Liverpool, the estimated total cost being £100,000, has been approved by Liverpool City Council. The spoil removed from under the bed of the Mersey in the construction of the Mersey Tunnel will, it was stated, be utilised in the work of reclaiming about fifty acres on the river front. The proposed promenade will be a mile and a-half in length.

Non-ferrous Metals.

A markedly better finish, on balance, has been shown by every section of the non-ferrous metals market during the past week, values in all cases registering an improvement compared with a week ago. The recovery has been the more notable in respect of tin, following an equally substantial improvement reported a week ago, and closing prices at the time of writing are higher than at any time since the end of January. There has been a good volume of buying going on from domestic users of the metal, but, to a large extent, the rise during the past week must be attributable largely to American and continental influences, as inquiry from all directions has been much more active than of late. So far as actual business is concerned, conditions in respect of copper have not been satisfactory, and the demand, both for refined and standard descriptions, has been on a rather restricted scale. In spite of this, however, values have moved up, and have closed at higher levels than for the past six weeks. Spelter has firmed up a little, and current quotations are about where they were a fortnight ago, before last week's decline. The improvement, however, is due rather to cautious offerings of the metal than to any decided broadening of the demand. Buying interest in the case of lead has been on moderate lines, but, to some extent, in sympathy with the other sections of the market, values have stiffened.

Iron.

The demand for foundry pig iron here since my last report has been decidedly quiet, and beyond a few relatively unimportant replacement contracts, there has not been much business done this week. If anything, conditions at the moment are even quieter than during the past few weeks. This may be due to two factors extraneous to actual economic conditions at the consuming end of the trade. A number of foundries locally have been busily engaged on stocktaking operations, and in some cases have been extremely reluctant to add to their stocks of raw materials for the present. Another factor, though one which is probably more sentimental than practical in view of the comparatively short stoppage, is the quiet period which usually precedes a holiday. Notwithstanding the poor support which sellers have been accorded in this part of the country, at all events, there has been pronounced steadiness in all sections of the pig iron market, allowing, of course, for the inevitable though relatively few weak sellers. For Midland makes prices have been maintained at 71s. 6d. per ton for Staffordshire No. 3, and about 72s. 3d. for Derbyshire, North-East Coast makers quoting at 79s. 2d., including delivery in each case to Manchester or equal distance. For hematite iron the delivered price this week has varied between 84s. and 84s. 6d. per ton. Scottish iron has latterly shown a firmer tendency, and whereas offers for delivery in this area a week ago were being made at from 86s. to 87s. 6d. current values are from 87s. 6d. to 90s. per ton, according to brand. Lancashire makers of bar iron decline to reduce their quotations from the levels that have been ruling for several months, in spite of the limited business that is coming their way. Crown bars are at £10 per ton, and second quality materials at £9 10s.

Steel.

A moderate more or less day-to-day business is being done on the steel market, constructional engineers furnishing the bulk of the trade, though there is also a certain amount of buying going on in boiler plates for the locomotive-building industry and in miscellaneous descriptions of steel for general engineering. Apart from small re-rolled bars, in which section keen competitive prices are again being met with, quotations are steady all round, joists being offered at £7 17s. 6d., ship and tank plates at £8 12s. 6d., boiler plates at from £9 15s. to £10, according to quality, and large steel bars at £8 17s. 6d. Small rerolled bars are usually quoted at about £7 12s. 6d. per ton, but about 2s. 6d. below this figure is being accepted in some instances. Renewed easiness in continental steel products is discouraging buyers from operating with any degree of freedom, and orders reported this week have been both few and small. For delivery to buyers' works in Lancashire, imported billets are now quoted at £5 6s. per ton, sheet bars at £5 11s., steel bars at £6 6s., Siemens plates at £7 14s., Thomas plates at £7 4s., sections at £5 15s. to £5 16s. 6d., and bar iron at £6 4s.

BARROW-IN-FURNESS.

Hematite.

There is still a quietness in the hematite pig iron trade in this district. New business is not in evidence, and production is restricted. But for the fact that the requirements of the local steel departments are heavy, there would have to be a very considerable reduction in the production of iron. Stocks are being cleared, but only slowly, at the works, which are not producing at all, and there has been a tendency for stocks to increase at other works which are engaged in the production of pig iron. The overseas trade is very moderate indeed, and there are no signs either at home or abroad of any revival as yet. There will be a falling off at Easter owing to the fact that the local steel mills will be closing down. There is a rumour to the effect that stocks at Ulverston are now getting down, and of a possibility of the works restarting shortly. In the iron ore trade most of the demand is on local account, but there is a certain amount of business with outside customers for best qualities. In the steel trade the rail mills continue to work and have been engaged upon colonial and Irish orders. Last week rails were made for Port Sudan and Dublin. New orders are still scarce, and in view of the shortage the rail mills at Barrow will cease at Easter. It cannot be said at present when they will restart. The hoop mills are enjoying a good trade, and there is a fair demand for castings.

Shipbuilding.

The English Channel steamer "Victoria," which was purchased from the Southern Railway by the Isle of Man Steam Packet Company, is now at Barrow undergoing alterations and overhaul at the hands of Vickers-Armstrongs. She will probably run on the service this season, and there is a likelihood of the Isle of Man Company purchasing at least two more vessels in order to bring its fleet up to full strength.

SHEFFIELD.

(From our own Correspondent.)

Demand for Railway Material.

ONE of the more satisfactory features of the local steel trade at present is the activity of the departments which supply railway materials. There is usually a fair volume of work on hand in this branch, but for a considerable time it was much below the capacity of the plants. The reports of one or two companies, recently published, show that there was an improved demand last year, and this improvement is maintained, with the result that some of the axle and tire departments are busier than they have been for several years. In addition to the work which is being done for the home companies, there are substantial orders on hand from India, South America and other overseas markets. It is still impossible, however, to keep the plants running continuously, owing to the great increase of capacity during the last few years, and there are costly intervals of slackness. Under modern systems of tire rolling, production has been so speeded up that at one local works, with an average output of forty per hour, as many tires can be turned out in an eight-hour shift as required a week to produce twenty years ago. As the general demand from the railways is not much greater than before the war, the city's present facilities are in excess of requirements

A Downward Trend.

Generally speaking, the steel trade, at any rate in ordinary lines, shows a falling off in activity on the week. For billets, the inquiries are few and of small dimensions, while the quantities that are being specified under contract are unsatisfactory. There is a decline in the volume of work at the rolling mills, most of which report that their customers' requirements show a reduction. There has been a good trade in sheets for several years, but it has now fallen off, and comparative quiet prevails. The debenture holders of the Carbrook Steel Works, Ltd., a private limited company, have appointed a receiver. This step illustrates the difficulties which are being experienced in the rolling mill trade, principal among which is the smallness of individual orders, which means frequent changing of rolls and loss of profit. At many local works it is being found necessary to effect economies, and they have sometimes to be made at the expense of the staffs, as in the case of one large works where, it is reported, all salaries have just been reduced by 25 per cent. There is a serious drop in the demand for colliery requisites.

Vickers Progress.

The annual report of Vickers, Ltd., confirms the belief, aroused by the preliminary dividend announcement, that the company had had a much improved year. After payment of debenture interest and provision for depreciation, the net profit was £992,985, which is the best return since the abnormal results during the war period, and compares with £562,283 for the year 1926. In addition to paying a dividend of 8 per cent. on the ordinary shares, the board proposes to place £238,211 to the reserve fund—as against £200,000 for the previous year—and to carry forward £208,722—as against £134,858. The directors mention that the profits shown have been derived entirely from trading and dividends on investments, the profits on the sale of investments having been transferred to capital reserve account. Reference is made in the report to the fact that, under the recent scheme of amalgamation, the businesses at Sheffield, Barrow, Erith and Dartford have been sold to the new company of Vickers-Armstrongs, Ltd. It is also announced that the directors are making arrangements to transfer the company's works at Weybridge and the aviation business carried on thereat to a new subsidiary company, to be called Vickers (Aviation), Ltd. Further, it is proposed to transfer the Crayford works and the business carried on thereat to a new subsidiary company to be called Vickers (Crayford), Ltd. The directors consider it will be more convenient in working if these businesses are constituted as separate companies.

A Successful Introduction.

Edgar Allen and Co., Ltd., report that their new "Stag Major" tool steel is attracting great attention. Trial orders for it have come in in such large quantities that it has been a problem to cope with the rush, because, although the number of orders runs into three figures, most of them are for different sizes and shapes of tools, which makes it difficult to execute them quickly. The firm also states that during the past month some further very good business has come to its engineering department, notably a good order for rotary dryers from a northern firm.

A Ball-bearing Acquisition.

It is announced that Brown Bayleys' Steel Works, Ltd., of Sheffield, has acquired a controlling interest in the Hoffmann Manufacturing Company. Hitherto, the controlling interest has been held by the United Steel Companies, Ltd.

The Lighter Trades.

The depression in the saw trade shows some signs of lifting, but the demand for both hand and circular varieties is still a good deal below the average of the past few years. Continued quietude is reported in the file trade. Some classes of engineers' tools are enjoying a fair amount of activity, but the tool trades as a whole are badly off for bulk orders. The export call for farm tools and knives is pretty good, and the scythe makers are able to dispose of the whole of their output. There is no improvement to record in the cutlery and plate trades, in which conditions are irregular and, on the whole, far from satisfactory. The Cutlers' Company is waging a campaign against the misleading marking of cutlery, and last week it was successful in a prosecution which was brought as a warning to certain cutlery manufacturers. The defendant was fined £5 and £5 costs for marking on the blades of 200 gross of knives "Best English cutlery, Sheffield," when their quality was not the best. It was stated in evidence that the knives, although good value for the money, were much below the best quality. Counsel for the prosecution said they were by no means the worst made by persons who produced inferior knives, but at the same time they were third or fourth-rate knives.

Winding Engines for South Africa.

Markham and Co., Ltd., of the Broad Oaks Works, Chesterfield, are erecting a pair of winding engines which are to be installed at the Randfontein Mine, South Africa. The engines will be used for winding men in a vertical shaft, 5000ft. deep, and they weigh 350 tons. The winder differs from standard English practice in many points. The most notable of these is that it has two drums, both of which are loose on the shaft and driven by means of multiple tooth clutches, having thirty-two teeth in each. Messrs. Markham are also building another pair of winders for use in South African gold mines.

NORTH OF ENGLAND.

(From our own Correspondent.)

Communist Crusade in Coalfields.

TAKING advantage of the depression in the Northern coal trade, Communist agents have been particularly active during the past two or three weeks in endeavouring to stir up strife among the miners, and as a result several more stoppages have taken place at pits in both Northumberland and Durham. The recent county awards through which the wages, particularly of the lower-grade men, have been reduced, have provided an excellent opportunity for furthering their propaganda. Almost every pit village has had its agent, who, in addition to gaining the adherence of some local man, has patiently circulated inflammatory literature in the hope that the mis-statements and allegations in these pamphlets would bear fruit. There are definite signs, however, that the crusade is fizzling out, and that the miners are realising the futility of such stoppages. This week there has been a general resumption of work at the Horden and Shotton Collieries, which were closed down as the result of restriction of output by the putters. Horden Colliery has been idle since March 14th and Shotton since March 15th. The men gave an undertaking that the restriction would cease, and provided they carry out their promise, it is understood that the fourteen days' notice already served upon them at both collieries will be withdrawn. Harton Colliery, South Shields, which was laid idle owing to trouble with the putters, also resumed operations this week.

Continental Competition Again ?

There is every indication that the iron and steel industries in this area will be faced with another spell of continental competition. Evidence of such a possibility is certainly stronger at present than at any time during the past few months. A rise in the standardised quotations for Cleveland iron has been followed by signs of lowering continental prices. Hitherto, makers on the Continent have been unable to devote much attention to the English market, owing to pecular troubles of their own. Moreover, they have been kept working all along at fair pressure. Now they are said to be keen on securing orders, and are prepared to negotiate for delivery at a fairly early date. Recent sacrifices by Cleveland ironmasters and men had succeeded in putting a stop to the imports of foreign pig iron to the Tees. Cleveland, in fact, had only just begun to anticipate some expansion of orders for her products when the shadow is cast again. So far there has been no development to justify the conclusion that imports of continental iron to the Tees would be resumed, but certain signs are gathering in that direction.

Cleveland Iron Trade.

Steady conditions and quiet confidence still characterise the Cleveland pig iron market, current sales being satisfactory and the outlook encouraging. Some change has been discernible in the situation on the Continent, but nothing materially detrimental to Cleveland's trade has yet developed, though the easement in value of certain foreign products is regarded as significant. Cleveland ironmasters adhere firmly to their fixed rates. The statistical position is very strong. The needs of producers' foundries and steel works continue to absorb a large proportion of the make, and the surplus output available for the open market is insufficient to meet requirements, with the result that makers' stocks, which are small, are still being reduced. Continental inquiries are few, but home business is on an increasing scale, and hope of continued trade with Scotland is expressed, though, in addition to competition from Lincolnshire and Northamptonshire, conditions may admit of considerable use of continental iron in Scotland. No. 1 Cleveland foundry iron is 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is most discouraging. Demand shows little improvement, and values keep comparatively low. Inquiries for ordinary brands are few and small, but prices for iron made to stipulated analysis are still ruled by the quotation for mixed numbers, which stands at 70s. per ton. Despite the restricted output, stocks are stated to be heavy.

Ironmaking Materials.

Fairly large deliveries of foreign ore are being made under running contracts, but new business is very quiet. Sellers, however, hold that supply will be far from plentiful as the year advances, and they do not name below 22s. per ton as the c.i.f. Tees price of best Rubio ore. Ironmasters are not disposed to negotiate for extensive quantities of coke. Supply is ample, and good medium sorts are on offer at 18s. per ton delivered at the works.

Manufactured Iron and Steel.

Producers report a very quiet demand at the moment, but they are fairly well booked with orders to ensure the present state of activity at the works for some time to come. Still more orders would be very welcome. All prices are maintained, and consumers do not expect to see them lower than they are at present. Especially is this so in the case of plates, angles and other shipbuilding materials, which are in brisker demand. Further contracts for semi-finished steel are understood to have been made, but rumours of an easier tendency in continental steel are disquieting.

The Coal Trade.

The Northern coal trade gives no signs of any increased activity, but the position all round is reported to be very steady, and fitters generally are quite comfortably situated, both as regards orders and tonnage stemmed. The labour situation is brighter, several pits have been reopened, and the outputs are quickly expected to reach

the normal. This will, of course affect prices for after Easter, as with increased supplies available, merchants are not inclined to operate ahead. The loss practically of the whole of the Swedish, Norwegian, Danish and Finnish railway orders, and the feeling that the Lithuanian order will go abroad, gives merchants a strong impression that trade for April to June is going to be scarce, and that the coalowners will have great difficulty in keeping the pits at work on the present scale. Another important order usually placed in Northumberland has gone to Poland—that of the Finnish State Railways, which were in the market for 30,000 tons of steam coals for shipment over the summer months. It is understood that Poland will supply 20,000 tons, and the balance of 8000 tons is for Scotch coal. A welcome order is that of the Belgian State Railways, which have negotiated through merchants for the supply of 20,000 tons of second-grade Northumberland steams and for 5000 tons of good class Northumberland nuts. There are not many foreign inquiries at the moment, but there are substantial home contracts for utility companies to be placed shortly. The direct price of best Northumberland steams is firm at 13s. 6d. and second-hand holders are asking little less than that figure. Tyne primes and seconds are tolerably brisk, but smalls are still in slow demand. Durham gas coals are very steady at 15s. to 15s. 3d. for best qualities, and 13s. 3d. to 13s. 6d. secondary kinds. There is a steady improvement in bunkers of the higher class and for all kinds of coking coals. The production of coke of all grades continues in excess of requirements, but stocks are not yet excessive, and makers hold steadily against giving any further concessions. Gas coke is at 20s. 6d. to 21s.; patent oven, 16s. 6d. to 17s.; special makes, 23s. to 24s.; and beehive, 24s. to 27s.

SCOTLAND.

(From our own Correspondent.)

No Improvement.

THE position in the steel, iron and coal industries is more or less unchanged, and the outlook is still very uncertain. The recent hardening of continental prices engendered a more hopeful feeling amongst manufacturers of steel and iron that at last the tide had turned, but latest advices have caused a reaction to the former state of affairs. So far as the coal trade is concerned, the position has been gradually going from bad to worse owing to keen continental competition and restricted home demands. The former has proved an effective barrier to the export trade, the loss of which will in all probability result in some collieries taking early advantage of the scheme which provides for compensation to those collieries closing down in order to reduce outputs. The compensation fund is to be raised by a levy of sixpence per ton on all land sales.

Steel.

Practically all classes of consumers of steel continue to buy only sufficient quantities to meet actual requirements, and with these on a restricted basis, the producing works are poorly engaged. The aggregate tonnage in plates and sections is small, and the production costs of the latter are occasionally increased owing to the fact that rolls have sometimes to be mounted for less than normal quantities.

Steel Sheets.

The majority of the sheet mills keep moving. Light sheets are busier than heavy, and the works could undertake more business in either. Black steel sheets ¼in. are quoted £8 12s. 6d. per ton, and 10-gauge about £8 15s. per ton. Galvanised corrugated £13 7s. 6s. to £13 10s. home and £13 5s. per ton export.

Iron.

Neither bar iron nor re-rolled steel bars are active, owing chiefly to foreign competition, and the outlook is not encouraging.

Pig Iron.

A slackness in foreign competition and the firmer ore market combine to produce a somewhat firmer attitude in foundry qualities, but there is, however, no increase in business.

Exports and Imports.

During the past week 7750 tons of iron ore and 2000 tons of chrome ore and 700 tons of steel and iron products were discharged at Glasgow. Shipments of steel and iron only amounted to 5200 tons, which went chiefly to Australia, India, South Africa, Chile, and Spain. Shipments of pig iron amounted to 449 tons.

Coal.

The general position in the Scottish coal trade is unchanged. Owing to the probable reduction of outputs, already referred to, exporters are not disposed to discount colliery prices, and forward business is practically at a standstill, while orders for prompt shipment are almost negligible. Of contracts recently tendered for on account of the Finnish State Railways and amounting to 30,000 tons, only some 8000 tons come to Scottish exporters, the rest being Silesian coal. This following on the result of the Swedish State Railways contracts provides further evidence of the prevailing state of affairs. Aggregate shipments from Scottish ports during the past week amounted to 229,133 tons, against 237,026 tons in the preceding week and 236,269 tons in the same week last year. Home demands for municipal, industrial and household purposes are below normal. Collieries are not always successful in securing the extra sixpence per ton from industrial works, while gas and electricity works and railways are not disposed to concede the additional 1s. 6d. per ton asked. These increases are, of course, the extra charge in connection with the levy to raise funds for the compensation scheme.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE improvement which was recently apparent in the steam coal industry has not been maintained. The volume of shipments last week from the whole of this district, including steam and anthracite coals, turned out to be disappointing. It was scarcely expected that the total would be up to the level of the week before, when over 510,000 tons were shipped, yet at the same time it was thought that the quantity would have been above 438,864 tons. Still it has to be admitted that the supply of tonnage available fell away considerably during the second half of last week, and on Saturday the official report was that, taking the whole of the docks, the number of idle loading appliances reached the high figure of fifty-four. It is questionable whether there will be any appreciable improvement in the returns for this week, as on Monday there were still thirty-seven idle tipping appliances, which shows that the arrivals of steamers over the week-end were disappointing. It does not look, therefore, especially in view of the general inquiry, as if there is going to be an abnormal pressure on the eve of Easter, except possibly so far as some of the better quality coals are concerned. The foreign demand continues to be on very moderate lines, not only so far as current shipments are concerned, but also for supplies over a period. In the case of the Egyptian State Railways contract recently concluded, it will be recalled that firms were asked to tender for 340,000 metric tons of large coals, and the lowest price put in was that by Watts, Watts and Co. of 26s. 8d. per ton c.i.f. Alexandria, the coals being for delivery over a period of about six months. It now appears that the railways have not placed the contract for the full amount, but have cut down the quantity to 225,000 metric tons, it being their intention to call for fresh prices for 100,000 to 150,000 metric tons without stipulating for Welsh coals, which will mean that the competition of North Country and German coals will have to be faced. The Portuguese State Railways have bought 100,000 tons of best steam smalls through one of the big local combines for delivery at Lisbon and other Portuguese ports over a period of about six months.

Coal Stabilisation Scheme.

Last week the Committee appointed to complete the South Wales Coal Marketing Association's deed of association met at Cardiff and received the replies of the colliery companies as to whether they would join the Association. It was decided, as a result of the information received, to complete the formation of the Association immediately. According to the secretary of the organisation, the response of the colliery companies was considered to be very satisfactory. He further pointed out that the members of the Committee which had been dealing with the matter had had a long and arduous task, and many difficulties to contend with, but most of these had been overcome and the remainder would be dealt with by the Executive Committee. Since then there have been meetings of the colliery representatives for the purpose of appointing their representatives on the group committees, and on the Executive Committee which will control the operation of the scheme. Nothing official as yet has been issued as to when the scheme is to come into operation, and it is stated that work has still to be done in the way of the classification of coals and the fixing of the minimum prices, though it is understood that the latter will very closely approximate the figures now ruling on the market, commencing with best Admiralty large at 19s. 6d. per ton.

Trimming and Other Matters.

Last week the National Coal Trimming Board met in London, when the chief matter for discussion was the application of the workmen for the revision of the shift arrangements, which involve the abolition of the night shift and the restoration of the two continuous shift system. The sub-committee representing the employers and the men failed to reach any basis of settlement, and as the result the proceedings were abortive. At the annual meeting of the Commercial Committee of the South Wales Coalowners' Association, held at Cardiff on Friday last, Mr. Norman J. McNeil, of the Tredegar Iron and Coal Company, was elected chairman for the ensuing year, and Mr. Paul Cocks of Swansea was appointed vice-chairman. The South Wales Coal Exporters' Association has sent out to its members a circular which states that some months ago the French Government proposed to increase the import duty on British coals to six francs, but the Association has now received information from the British Government to the effect that the French Government has indicated that it does not intend to act on the proposal.

Coalowners' Association.

At the annual meeting of the Monmouthshire and South Wales Coalowners' Association, held on Tuesday, Mr. Thomas Evans, of Ocean and Wilsons, Ltd., was elected chairman, and Sir David R. Llewellyn, Bart., of Gueret, Llewellyn and Merrett, Ltd., was elected vice-chairman for the ensuing year. It was reported by the secretary that the output for 1927 reached a total of 43,498,197 tons, viz., Cardiff district, 25,651,812 tons; Newport district, 11,859,781 tons; and Swansea district, 5,986,604 tons.

Tin-plate Ballot.

Recently a ballot was taken of the higher paid men in the tin-plate industry of South Wales as to whether they should accept the offer of the employers of a reduced *ex gratia* bonus of 2½ per cent. for the ensuing six months, with the condition that the men should make no new general claims within the period of its operation, or whether they would refuse it and be free to make any fresh claims. The result of the ballot has now been declared as follows:—For the employers' offer, 9378; and against acceptance of the offer, 4827.

Current Business.

The tone of the market has become rather quieter. Some of the leading undertakings are very fully stemmed right up to Easter, but the majority of collieries are in need of business, and many are working irregularly. In some quarters the view is held that the impending operation of the stabilisation scheme is holding up inquiries. Small coals continue firm, but the demand for sized qualities has rather fallen off. Patent fuel and coke display no new feature, but pitwood has improved and is quoted round about 28s. 6d. to 29s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

H. G. BLAKEMORE asks us to announce that he has transferred his offices from 180, Piccadilly, W. 1, to Windsor House, Victoria-street, S.W. 1. His new telephone numbers are Victoria 8060–1.

ROSE, DOWNS AND THOMPSON, Ltd., of Old Foundry, Hull, ask us to announce that they have taken over the business, goodwill, drawings and patterns of Robert Middleton and Co., of Leeds, and that they are now in a position to supply any machinery or renewals for machinery previously supplied by that firm.

CATALOGUES.

THE SUPERHEATER COMPANY, Ltd., 195, Strand, W.C. 2.—Pamphlet No. L 7a, dealing with the "M.L.S." multiple valve regulator header.

THE ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Publications No. 839, "English Electric High-speed Circuit Breakers"; No. 900, "English Electric Kosfi-Leading Induction Motors"; No. 988, "Wilkinson Change-circuit System with English Electric Induction Regulators."

G. D. PETERS AND CO., Ltd., Caxton House, S.W. 1.—A general sectionalised catalogue of rolling stock equipment, including the following:—Blinds, clutches, patent coil type; heating equipment—steam and hot water; seats and seating—for railways, tramways and omnibuses; pneumatic door apparatus—for railway carriages and trams; electric welding plant and electrodes.

THE WORK METER.—We are asked to state that the "Work Meter," described in our last issue, is made for Work Meters, Ltd., London, by the Automatic Telephone Manufacturing Company, Ltd., Strowger Works, Milton-road, Edge-lane, Liverpool.

INSTITUTION OF MECHANICAL ENGINEERS.—In our report of the meeting of the Institution of Mechanical Engineers held in London on March 16th we inadvertently referred to Mr. F. A. Lemon as *assistant* works manager at Crewe. Mr. Lemon has been works manager at Crewe since 1920.

THE INSTITUTION OF ENGINEERING INSPECTION.—On Monday last the Institution of Engineering Inspection held its annual dinner at the Trocadero under the chairmanship of Mr. H. J. Davey, the President. Lord Riddell was the guest of the evening. He proposed the toast of "The Institution" in his best after-dinner manner, and Mr. Davey responded. The only other toasts were "The Guests" and "Empire Trade." The former was proposed by Sir Robert Jackson and acknowledged by Captain A. C. N. Dixey, M.P. The toast of "Empire Trade" was proposed by Mr. L. Pendred, and elicited a reply from the Hon. J. L. Price, in which many interesting facts about Australian trade with the Mother Country were given. After dinner many of the ladies and gentlemen remained to dance and so brought a pleasant evening to an end.

RAMSAY MEMORIAL LABORATORY OF CHEMICAL ENGINEERING.—The Chemical Engineering Building and Equipment Fund Committee, of which the Right Hon. Sir Alfred Mond, Bart., is chairman, Sir Robert Waley Cohen vice-chairman, and Sir David Milne-Watson hon. treasurer, recently issued an appeal for a capital sum of £50,000 for the extension of the Ramsay Laboratory of Chemical Engineering at University College, London, and for its equipment. The response up to the present time has produced £23,555. In addition to the capital fund for the building and equipment, an income of £6000 a year is required for the maintenance of the laboratory. Towards this, £3191 have already been promised for the first five years and £2600 for the second five years. The Committee is anxious to complete both funds as speedily as possible in order that the new building may be proceeded with. Donations and subscriptions may be sent to Sir David Milne-Watson, at University College, London, Gower-street, W.C. 1, who will be glad to supply any further particulars.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—The annual dinner of the Institution of Structural Engineers was held on Monday last, March 26th, at the Park Lane Hotel. Close upon four hundred members and guests, including ladies, attended and were received by the chairman of the evening, Mr. Henry J. Deane, President of the Institution, and Mrs. Deane. The toast of "Our Country and the Empire" was given by Dr. H. Costley-White, the headmaster of Westminster School, and was acknowledged by the Marquess of Londonderry. Lieutenant-Colonel J. Mitchell Moncrieff submitted the toast of "The Guests," to which Sir Lynden Macassey and Captain Valentine Williams responded. Mr. F. E. Trench, the President of the Institution of Civil Engineers, proposed the toast of "The Institution of Structural Engineers." In his reply the Chairman stated that the Institution had now a membership of well over three thousand, and that next year it would celebrate its twenty-first year of existence. After the dinner a dance took place with an entertainment. The evening was a most successful and enjoyable one.

THE COMMERCIAL MOTOR USERS ASSOCIATION.—If one may judge from the ever-increasing attendance at the annual luncheons of the Commercial Motor Users Association, the number of people who now employ self-propelled vehicles in their business must be going up by leaps and bounds. This year's luncheon was held at the Savoy on Tuesday last, under the chairmanship of the President, Mr. E. S. Shrapnell-Smith, with Sir William Joynson-Hicks and Lieut.-Colonel Wilfrid Ashley as the principal guests. There was naturally a good deal of reference to the railways and road transport. The chairman, proposing the toast "His Majesty's Ministers," said that the Association was not opposed in principle to the co-ordination of road and rail traffic, but he asked for safeguards for the smaller owners. Sir William, in responding to the toast, dwelt upon the value of road transport, and touched upon the thorny question of speed limits and traffic control. Colonel Ashley, giving the toast of "The Association," said that as Minister of Transport he had to hold the balance between rail transport and road transport interests. He did not think that powers should be withheld from the railways. The interest of the general public must be the ruling and final consideration. He hoped that the Road Traffic Bill would become law during the life of the present Parliament.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 10 0 to 3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 10 6	3 10 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 3 6	—
(3) Northampton—		
Foundry No. 3	3 0 0 to 3 1 0	—
Forge	2 14 0	—
(3) Derbyshire—		
No. 3 Foundry	3 4 0 to 3 4 6	—
Forge	2 19 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 4 0	—
No. 4 Forge	3 2 6	—
Basic	3 2 6	—
(4) N.W. Coast— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (a) / 4 5 0 (b) / 4 8 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	10 0 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 5 0	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0	—
Gas Tube Strip	11 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 7 6	13 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 2 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 12 6	—
Hoops (Baling)	10 5 0	10 0 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6	—
,, (Lancs. Boiler)	10 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0	—
Hoops	9 10 0 to 10 10 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	7 7 6 to 8 0 0	—
Billets and Sheet Bars	5 15 0 to 6 0 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 5 0 to 13 7 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	239 17 6
,, (three months)	239 5 0
Copper (cash)	61 11 3
,, (three months)	61 12 6
Spanish Lead (cash)	20 0 0
,, (three months)	20 8 9
Spelter (cash)	25 2 6
,, (three months)	25 0 0
Manchester—	
Copper, Best Selected Ingots	65 15 0
,, Electrolytic	67 5 0
,, Strong Sheets	92 0 0
,, Tubes (Basis Price), lb.	0 1 1
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	21 12 6
,, Foreign	20 12 6
Spelter	25 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 15 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 7 6	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£22 5 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£35 0 0	12/-
,, ,, ,, 1 p.c. carbon	£40 10 0	15/-
,, ,, ,, 0·70 p.c. carbon	£50 0 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/11 per lb.	
Ferro Manganese (per ton)	£13 10 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 17 6 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/11 per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£172	
Ferro-Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	16/9 to 17/3
,, ,, Trebles	13/6
,, ,, Doubles	12/6
,, ,, Singles	11/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/-
,, ,, Jewel	15/6
,, ,, Trebles	13/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 12/-
Screened Navigation	18/-
Trebles	12/- to 12/3
Doubles	12/-
Singles	11/-
Lothians—	
(f.o.b. Leith)—Best Steam	12/3
Secondary Steam	12/-
Trebles	12/3
Doubles	11/6 to 11/9
Singles	11/3

ENGLAND.

(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/-
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/- to 15/3
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	17/6
Sheffield—	Inland.
Best Hand-picked Branch	27/6 to 29/6 —
Derbyshire Best Bright House	20/6 to 21/6 —
Best House Coal	19/- to 20/6 —
Screened House Coal	16/- to 17/6 —
,, ,, Nuts	15/- to 16/- —
Yorkshire Hards	14/6 to 15/6 —
Derbyshire Hards	14/- to 15/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	17/- to 18/-

(9) SOUTH WALES.

Cardiff— Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/6 to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	17/- to 17/3
Western Valley Large	16/6 to 16/9
Best Eastern Valley Large	16/6 to 16/9
Ordinary Eastern Valley Large	16/- to 16/3
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	11/- to 12/6
Washed Nuts	18/- to 23/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/9
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	30/- to 37/6
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	21/6 to 23/-
Pitwood (ex ship)	28/6 to 29/-
Swansea— Anthracite Coals:	
Best Big Vein Large	30/- to 32/6
Seconds	24/6 to 27/6
Red Vein	20/6 to 25/-
Machine-made Cobbles	38/- to 41/-
Nuts	37/6 to 42/6
Beans	23/- to 27/-
Peas	17/- to 18/-
Breaker Duff	8/- to 8/6
Rubbly Culm	9/6 to 10/-
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	9/9 to 11/-
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Steel Consumption.

WHEN the steel trade fell under the burden of a huge surplus production the first idea of makers was to restrict the output, and the effect has been to avert a threatened collapse without, however, bringing activity to the industry. Then it became evident that the logical procedure was to stimulate consumption by a system of propaganda whereby new outlets would be found for steel, and that was the subject of a pronouncement made last week by M. Maurice Fould, the managing director of the Aciéries de Pompey. M. Fould stated that the steel consumption in France rose from 4,293,000 tons in 1913 to 6,086,000 tons in 1926, in which year the rate of progression reached its maximum. Since then it had fallen 20 per cent. In the same period the production increased from 4,687,000 tons to 8,386,000 tons, the increase being due to the incorporation of the Lorraine steel works and to the much greater capacity of the works which have been reconstructed in the devastated regions. Except for Belgium and Luxemburg, which manufacture for export, France has a larger excess of production per head of population than any other country. Therefore, the great problem consists in increasing the consumption per head of population sufficiently to absorb the entire production. M. Fould does not think that that is impossible. The prevailing use of reinforced concrete for building has, of course, a serious effect upon the steel trade, since the demand for rods does not compensate for the decline of business in girders, but there are many new fields for the more extensive employment of steel products, one of the most important being agriculture. The attempts being made in Germany to popularise the use of metallic wheels for all kinds of vehicles, and the construction of all metal railway coaches in France, are referred to as examples of what can be done in the way of opening up a wide scope for steel consumption.

Air Condensers.

A month or two ago there was held in Algiers a series of conferences lasting a week and devoted mainly to questions affecting the supply of water in areas that are liable to long and continued droughts, and also to methods of obtaining water in tropical and subtropical regions where the only source of supply is from the hot damp atmosphere itself. In many parts of North Africa the losses arising from droughts are incalculable. Any system which will ensure regular supplies of water will therefore not only contribute enormously to the prosperity of North Africa but may possibly give a value of arid wastes elsewhere. The conferences were summarised at a recent meeting of the Société des Ingénieurs Civils when special reference was made to a method of condensing the hot atmosphere, which appears to be based upon ancient ideas and is now giving quite satisfactory results. This is done by allowing the air to pass into a cool chamber, various forms of which are employed. One type has an ogival section and has very thick walls, preferably of a porous material. In the upper half are holes inclining downwards from the outside, while others incline upwards to ensure a circulation. The inner walls of the thick chamber are made with asperities to facilitate the formation of drops of water as the hot air, entering by the holes or canals, condenses on the cool surface. The water collects in a tank at the bottom underground. It is stated that the chamber will condense two or three litres of water per square metre of surface in a few hours.

Domestic Heating.

The Conseil d'Etat has approved of the convention which has been agreed upon between the Municipal Council of Paris and the Compagnie Générale française de Chauffage Urbain, whereby the latter company is granted a concession for the distribution in Paris of steam or hot water for domestic heating. The system employed will be similar to that in service in a number of towns in Germany, Denmark, Holland and the United States. The company is negotiating for the purchase of the abandoned Metropolitan power generating station in the rue de Bercy, and a main will be laid between that station and the generating station at Saint-Ouen of the Compagnie Parisienne d'Electricité, where exhaust steam will be utilised for the purpose. The main will thus traverse Paris from the Bastille to the Porte de Saint-Ouen.

Barrage Construction.

The protest of M. Gustave Mercier, President of the Comité Français des Grands Barrages, against the assertion of M. Mesnager that the solid barrages at present constructed do not offer a sufficient margin of safety, has elicited from M. Mesnager a further reply to the effect that the margin of safety of solid barrages of triangular section is so small as to offer a positive danger, particularly on account of the insufficient length of spillways which are subjected to abnormal pressures in times of flood. M. Mesnager states that the barrages at oued Fodda and oued Mina in Algeria are likely to meet the same disaster as that at Perrégaux ; that the barrage at oued Beth in Morocco is liable to suffer the same fate and that another dam which does not sufficiently provide for a release of pressure in times of flood, and may therefore collapse, is the barrage de la Curie in France.

Suction Gas from Charcoal.

Following upon the series of demonstrations of portable wood carbonising apparatus and of suction gas plants for motor vehicles which have been held of late years in different parts of the country, some trials of a more complete character are to be organised in June next in the Forest of Versailles. Competitors will be required to carbonise 150 cubic metres of wood, some of it freshly cut. A service of motor omnibuses with charcoal suction gas plants will run during the trials between Paris and the trial grounds, and an electric power station with charcoal suction gas engines will be installed to provide current to competitors.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

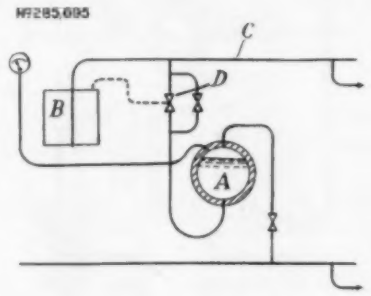
Copies of Specifications may be obtained at the Patent Office Sale Branch, 28, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

285,695. May 11th, 1927.—STEAM ACCUMULATORS, Aktiebolaget Vaporackumulator, 1A, Eriksbergsgatan, formerly of 18, Lastmakaregatan, both in Stockholm, Sweden ; and Dr. J. K. Ruths, Djursholm, Sweden.

This invention relates to steam accumulators in which heat is stored during such time as a boiler may be working under comparatively light load. The accumulator is shown at A and the

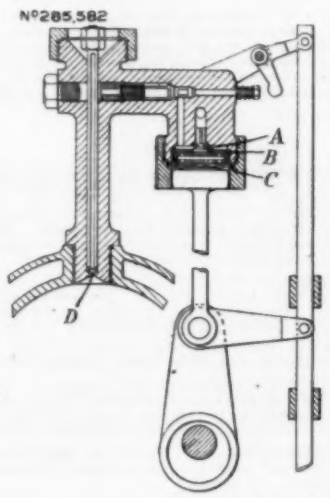


boiler at B. The connection between the two is effected by means of the main steam range C and is controlled by the valve D. Instead of, as heretofore, this valve being regulated by the pressure in the steam range, it is connected directly with the boiler by a pipe indicated by dotted lines, so that it is influenced immediately by the boiler pressure, rather than by the pressure in the steam range.—*February* 23*rd*, 1928.

INTERNAL COMBUSTION ENGINES.

285,582. November 20th, 1926.—LIQUID FUEL PUMPS, F. A. Cooper, 256, Bearwood-road, Smethwick, Birmingham.

One of the chief characteristics of this fuel pump is the attachment of the inlet valve A to a perforated diaphragm B. The actual pumping is performed by another diaphragm C, which is

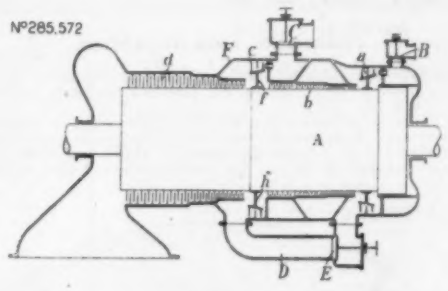


operated mechanically by the engine as shown. The perforated diaphragm normally keeps the inlet valve off its seating, but on the delivery stroke the diaphragm flexes, the valve closes and the oil is delivered to the spray D in the combustion space.—*February* 20*th*, 1928.

TURBINE MACHINERY.

285,572. November 18th, 1926.—STEAM TURBINES, The Hon. Sir C. A. Parsons, Heaton Works, Newcastle-on-Tyne, and E. H. B. Anderson, 2, Rector-street, New York, U.S.A.

The invention consists in an elastic fluid turbine or turbine unit having cruising impulse and reaction blading combined with main impulse and reaction blading together with by-pass arrangements and control valves such that the turbine can be operated at various powers in the manner hereinafter described. The accompanying drawing shows in sectional elevation an illustrative structural embodiment of the invention. In carrying the invention into effect according to this form the cruising impulse blading *a* and cruising reaction blading *b*, together with the main impulse blading *c* and main reaction blading *d*, are carried on a single rotor A in the sequence set forth. A regulating valve B is provided for admitting live steam direct to the nozzles of the cruising impulse stage, while a main regulating valve C admits live steam to the nozzles of the main impulse stage. Further, a by-pass D connects the exhaust side of the cruising impulse blading *a* to the exhaust side of the main impulse blading *c*, this by-pass being controlled by a suitable valve E. In addition, steam can by-pass the main impulse blading *c* either through that arc of the impulse wheel where there are no nozzles or through an external pipe or again through apertures *f* in the impulse wheel disc *h*. Both the cruising and main impulse stages may be provided with any suitable means for varying the number of nozzle jets in action so as to avoid throttling down at intermediate powers. The whole unit, which may be self-contained or form the high-pressure stage of a larger installation, is preferably contained within a single casing F. The turbine unit above described is operated as follows :—At full power the cruising regulating valve B is closed and the main regulating valve C opened, steam thus passing through the main impulse and reaction blading *c* and *d*, while the cruising impulse and reaction blading *a* and *b* rotates idly in steam at the pressure of the main impulse stage exhaust. Preferably the by-pass valve E in these circumstances is opened so that the low-pressure steam may circulate freely through the cruising blading *a b*. At intermediate powers the main regulating valve C is closed and the by-pass E and cruising regulating valves B opened. Steam then passes through the cruising impulse blading *a*, through the by-pass D to the main reaction blading *d*, thereby short-circuiting both the cruising reaction blading *b* and the main impulse blading *c*. In this case the idle parts rotate in steam at

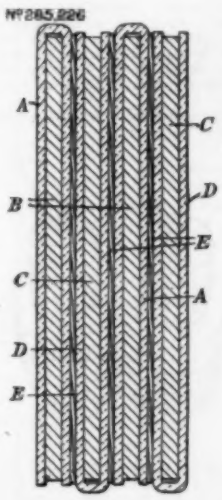


the pressure of the cruising impulse stage exhaust. Finally at cruising powers the by-pass E and main regulating valves C are closed and the cruising regulating valve B opened. Steam now passes through the cruising impulse and reaction blading *a* and *b*, by-passes the main impulse blading *c*—for example, by the disc apertures *f*—and continues through the main reaction blading *d*. Similarly in this case the idle stage, namely, the main impulse blading, rotates in steam at a low pressure. In the structural form of the invention above described it will be seen that there are no diaphragms or internal packings, while the windage losses are in all cases small, owing to the fact that the idle parts are rotating in steam which has been expended to a low pressure.—*February* 20*th*, 1928.

BATTERIES AND ACCUMULATORS.

285,226. January 18th, 1927.—IMPROVEMENTS IN AND RELATING TO STORAGE BATTERY CELLS, The D.P. Battery Company, Ltd., John Waddell, and Bernard Mervyn Drake, all of Lumford Mills, Bakewell, Derby.

This invention relates to storage cells in which glass wool felt comprising superimposed and cemented layers of fine glass filaments is interposed between adjacent plates. The object is to provide an improved arrangement of the glass wool felt sheets in relation to the plates. A sheet A of glass wool felt formed of,

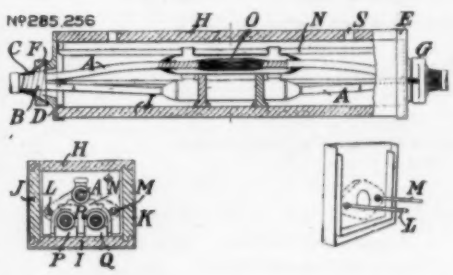


say, three layers of glass wool filaments are laid one upon the other and are connected together by cement, such as gelatine or sodium silicate. The sheet is folded around one end of a positive plate B so as to straddle the plate and completely cover both sides. The negative plates C are dealt with in a similar manner, but, as shown in the drawing, the fold in the glass wool felt D is at the opposite ends of the plates. A single sheet of porous wood E separates each unit from its neighbour.—*February* 16*th*, 1928.

TRANSMISSION OF POWER.

285,256. February 26th, 1927.—IMPROVEMENTS IN OR RELATING TO JOINT BOXES FOR ELECTRIC CABLE JOINTS, Pirelli-General Cable Works, Ltd., and Robert Eustace Horley, both of Western Shore, Southampton.

The joint box described in this specification is intended mainly



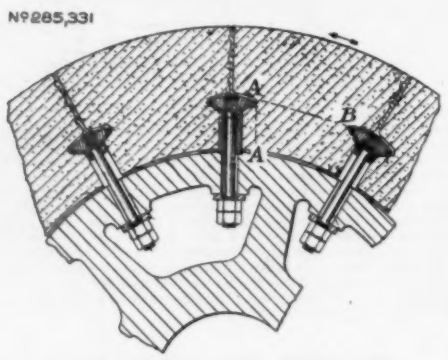
for high-tension cables. The cast iron end portions have apertures through which the cable ends pass. Each core of the cable shown has its own lead sheath A, the three single lead-sheathed cores being twisted up spirally. The spaces between the cores

are filled with packing material so as to form a circular cable, which is then provided with an armouring and finally a jute serving. The armouring consists of a phosphor-bronze tape B which holds the lead-covered cores closely together and a layer of steel wires C or two layers of steel tape outside the phosphor-bronze tape. The end portions D E of the joint box may each be constructed in a single piece or in several pieces and are each provided with a cast iron clamp F G. The top, bottom and side walls H, I, J and K are composed of concrete slabs, the whole being tightened up by means of two or more bolts L and M. A copper bonding strip N connects the two end portions D and E together. The joints may be made in any suitable manner and they are finally enclosed in a lead sheath O and are supported on earthenware supports P Q R. The top of the joint box is provided with filling holes S through which the filling material is passed.—*February 16th*, 1928.

CRUSHING AND GRINDING.

285,331. September 5th, 1927.—WHEELS FOR GRINDING WOOD PULP, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

This invention concerns a built-up abrasive wheel for grinding wood pulp. In the specification the inventor goes to some length to explain the "enormous" forces to which such stones are subjected, and points out the possible causes of their failure.

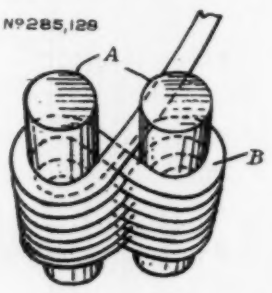


The drawing shows how the abrasive segments are attached to the drum, and the inventor states that he has found that if the distance A A is half the distance A B there is the least likelihood for the block to crack. He also uses nickel-steel bolts and puts them under such a tension that their elasticity will accommodate changes in dimensions due to variations in temperature.—*February 16th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

285,128. November 9th, 1926.—IMPROVEMENTS IN THE MANUFACTURE AND PRODUCTION OF ELECTRODES, WELDING RODS, AND THE LIKE, FOR USE IN ARC WELDING AND DEPOSITING METAL, Bertrand Turner, of 49, Golden Hillock-road, Small Heath, Birmingham; and Ferro-Arc Welding Company, Ltd., of 12, Grosvenor-gardens, London, S.W. 1.

A twin electrode is formed in accordance with this invention

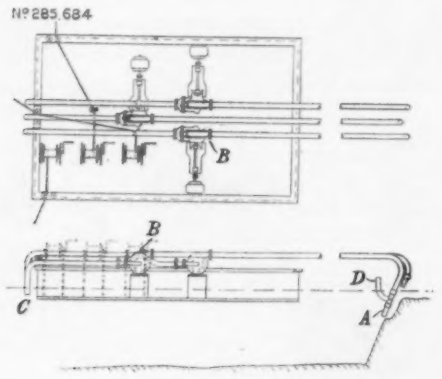


by taking two rods or wires A of suitable size and composition and combining them into a twin electrode by wrapping asbestos yarn B round them, the yarn being wound in the form of the figure 8. Preferably blue asbestos yarn is used, and to improve its welding properties the asbestos may have fluxes, such as lime, china clay, silicate of soda, and sodium carbonate, added to it.—*February 9th*, 1928.

MISCELLANEOUS.

285,684. April 20th, 1927.—A PROCESS OF DREDGING, R. T. Stewart, 217, Crawford-street, Dunedin, New Zealand.

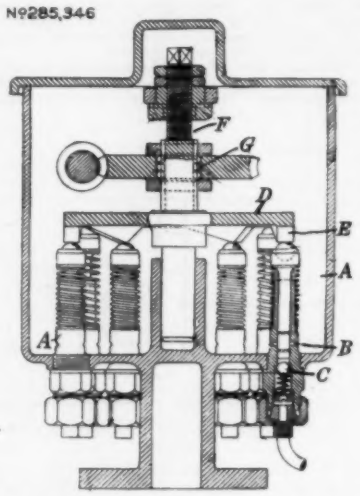
This invention is concerned with what may be described as jet dredging. That is to say, the loosening of material in navigable channels by means of water jets, so that it may be carried away by the current. The peculiarity of the arrangement lies in the fact that the jet of water "is surrounded by a sleeve of air which assists the jet to penetrate a body of water without losing its jet form or any appreciable part of its velocity."



The water jets A are produced by the pumps B sucking water at C. The orifice of the jet is surrounded by a sleeve which communicates with the atmosphere by the branch D. It is claimed that the jet is surrounded by the sheath of air desired. The inventor also states that an important feature of his invention is that the sleeve of air after having provided protection for the jet is broken up by the jet and forced in the form of globules along with the water into the material to be treated, causing the latter, impregnated by air and water, to assume a condition of violent ebullition, resulting in all mud being dissolved to flow away as dirty water and weeds to be torn out by their roots and carried away by the streams.—*February 23rd*, 1928.

285,346. November 17th, 1927.—MECHANICAL LUBRICATORS, A. S. Davidson, 18, Victoria-street, Westminster.

This lubricator is of the forced-feed type and the oil is delivered by means of the pumps A A, which have inlet ports B and delivery valves C. The pumps are operated by the rotation of



the disc D, which has cam faces E on its periphery. The stroke of the pumps can be varied by adjusting the height of the disc D by means of the screw F. The driving shaft is keyed on to its worm wheel by means of balls G, instead of a plain key, so that it is free to move axially.—*February 16th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

DIESEL ENGINE USERS ASSOCIATION.—19, Cadogan Gardens, London, S.W. 3. "Liquid Fuel from Coal," by D. Brownlie.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—Lighting Service Bureau. Dial House, Northumberland-street, Newcastle-on-Tyne. Annual general meeting. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. A discussion on "The Problem of Utilising the Earth's Internal Heat" will be opened by Mr. J. L. Hodgson. 7 p.m.

INSTITUTION OF NAVAL ARCHITECTS.—Spring Meetings. Royal Society of Arts, John-street, Adelphi, W.C. 2. For programme see page 302.

INSTITUTION OF WELDING ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. "Bronze Welding," by Mr. W. Steele. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "Locomotive Maintenance," by Mr. C. F. Adams. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Radio-active Atoms and their Structure," by Sir Ernest Rutherford. 9 p.m.

THE INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square. "Non-ferrous Metals in Relation to Ferrous Metallurgy," by Dr. W. H. Hatfield. 7.30 p.m.

THE INSTITUTE OF LOCOMOTIVE ENGINEERS (LONDON): MANCHESTER CENTRE.—In the College of Technology, Sackville street, Manchester. "Some Features of the Mechanical and Electrical Equipment of the Port of Manchester," illustrated by lantern slides, by Mr. W. G. Smith. 7 p.m.

SATURDAY, MARCH 31ST.

BOROUGH POLYTECHNIC INSTITUTE.—Borough-road, S.E. 1 Annual exhibition of students' work. 2.30 to 9.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the stained glass studios of James Powell and Son (Whitefriars), Ltd., at 98, Wigmore-street, W. 1. 2 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Transformation of Matter," by Sir Ernest Rutherford. 3 p.m.

MONDAY, APRIL 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Unity-street, Bristol, "Mixture Distribution in Multi-cylinder Engines," by Mr. J. N. Tait. 6.45 p.m.

INSTITUTION OF GAS ENGINEERS.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. Special meeting re proposed Royal Charter. 11 a.m. Visit to Staines. 2.15 p.m.

THE SURVEYORS' INSTITUTION.—At the Institution of Civil Engineers, Great George-street, Westminster. "Agricultural Depression: Its Causes and Possible Cures," by Mr. C. Dampier-Whetham. 8 p.m.

TUESDAY, APRIL 3RD.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the house of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. General meeting. "Electrical Characteristics of Spark Gap and Sparking Plug," by Mr. E. A. Watson. 7.45 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Paper to be submitted for discussion:—"An Experimental Determination of the Thickness and Distribution of the Oil Film in a Flooded Cylindrical Bearing," by John Goodman, M. Inst. C.E. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—The Hotel Metropole, King-street, Leeds. Annual general meeting, followed by a smoking concert. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—In the Electrical Engineering Lecture Room (No. 149), the Royal Technical College, George-street, Glasgow. "Higher Steam Pressures and their Application to the Steam Turbine," by Messrs. A. H. Law and J. P. Chittenden. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: SOUTH WALES BRANCH.—Royal Metal Exchange, Swansea. "The Possibilities in Rehabilitation of Existing Rolling Mill Equipment in British Steel Works," by Mr. G. A. V. Russell. 6 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Oil Well and Later Developments at Hardstoft, Derbyshire," by Mr. Arthur Wade. 5.30 p.m.

WEDNESDAY, APRIL 4TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Informal meeting. Subject for discussion:—"The Disposal of Sewage of Country Houses and Hamlets," by Gilbert Thorp Cotterell, Assoc. M. Inst. C.E. 6 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "The Study of Signal Fading" (the work of the Radio Research Station at Peterborough), by Professor E. V. Appleton, F.R.S. 6 p.m.

THE INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Visit to the Gas Light and Coke Company, Research and Training Centre, Watson House, Nine Elms-lane, Lambeth, London, S.W. 8. 5.30 p.m.

FRIDAY TO MONDAY, APRIL 6TH TO 9TH.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting in Guernsey.

THURSDAY, APRIL 12TH.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Variable Pitch Airscrew," by Dr. Hele-Shaw and Mr. T. E. Beacham. 6.30 p.m.

FRIDAY, APRIL 13TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. "Calculating Apparatus and Diagrams for Engineers," by Mr. A. P. Morris. 7.30 p.m.

THURSDAY, APRIL 19TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. The Nineteenth Kelvin Lecture, "Recent Advances in Physics," by Sir Oliver Lodge. 6 p.m.

THE INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Prince's Chambers, 6, Corporation-street, Birmingham. Annual general meeting. "The Sandfields Filters of the South Staffordshire Waterworks Company," by Mr. R. A. Robertson.

THURSDAY, MAY 3RD.

IRON AND STEEL INSTITUTE.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 7 for 7.30 p.m.

THURSDAY AND FRIDAY, MAY 3RD AND 4TH.

IRON AND STEEL INSTITUTE.—At the house of the Institution of Civil Engineers, Great George-street, London, S.W. 1. Annual meeting.

THE OPTICAL SOCIETY.—At the annual general meeting of the Optical Society, held on March 8th, the following officers and members of Council were elected:—President, Dr. R. S. Clay; Vice-Presidents, Messrs. D. Baxendall, H. H. Emsley, J. Guild, and F. C. Watts; Hon. Treasurer, Major E. O. Henrici; Hon. Secretaries, Professor A. F. C. Pollard and Mr. W. B. Coutts; Hon. Librarian, Mr. J. H. Sutcliffe; Editor of "Transactions," Dr. J. S. Anderson; members of Council, Mr. O. Aves, Mr. T. Chaundy, Dr. C. V. Drysdale, Mr. E. F. Fincham, Mr. E. T. Hanson, Instr.-Comdr. N. M. S. Langlands, R.N., Professor A. O. Rankine, Mr. H. C. Raxworthy, Mr. J. Rheinberg, Mr. R. S. Whipple, Mr. A. Whitwell, and Colonel H. S. L. Winterbotham.

INSTITUTION OF MECHANICAL ENGINEERS.—The annual dinner of the Graduates' Section of the Institution of Mechanical Engineers was held on Friday, March 23rd, at the New Molinari Restaurant, when Mr. H. W. Cadman took the chair. After the usual loyal toasts and a song by Mr. Lancaster, Mr. Harold Waghorne proposed "The Institution of Mechanical Engineers" and paid a tribute to the assistance which, he said, was always forthcoming from the secretary when the graduates were in need, as, for instance, in the preparation of a circular at the last moment. A rather quaint coincidence happened during the response by Mr. R. W. Allen. He was recounting how a floating dock was overturned through the faulty arrangement of the pumping system, and simultaneously there was heard a violent crash outside—caused by a taxi collision. The incident caused a lot of laughter. The toast of "The Visitors" was proposed by Mr. F. C. Johansen and was responded to by Messrs. R. E. L. Maunsell and R. A. Brockbank. Sir Henry Fowler proposed "The Graduates' Section, London," to which the Chairman responded.

SMALL FLEXIBLE COUPLINGS.—We have received from W. H. Dorman and Co., Ltd., of Stafford, some samples of small flexible couplings intended for such services as driving the dynamos and magnetos of internal combustion engines. They comprise two flanges keyed on to the shafts to be connected together, with a series of axial holes near their periphery. Into these holes there are fitted plugs of hard vulcanised rubber with a collar at the centre of their length to space the two flanges apart slightly. It is obvious that these plugs will provide a certain degree of flexibility, yet, being in shear, will transmit a considerable torque. The couplings are made in two sizes, 3in. and 4in. in diameter, and are provided with six rubber plugs, ¾in. in diameter. The flanges are bored out to the S.M.M.T standards, but can be made to suit customers' requirements. In the case of the magneto coupling there is an additional flange, and the pair are drilled one with eighteen holes and the other with twenty, so that a very fine angular adjustment can be made for timing purposes. The couplings are well-made, workmanlike jobs.